

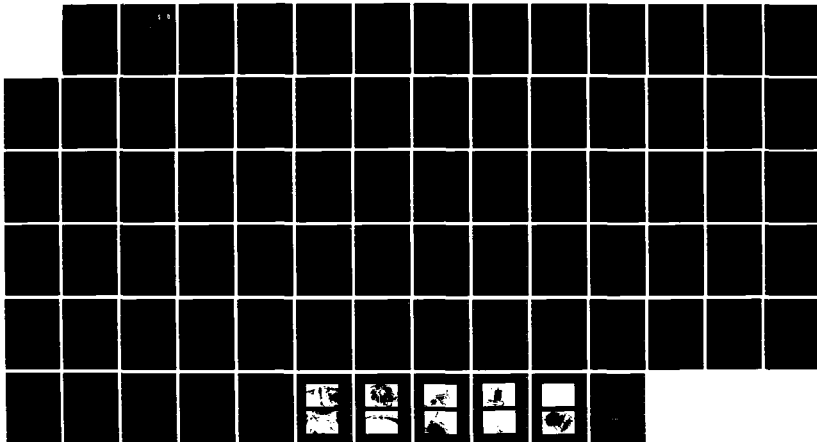
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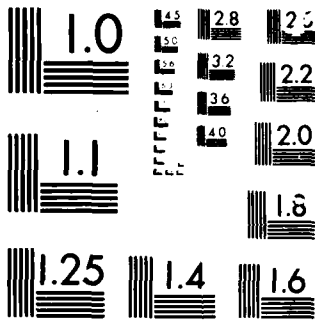
DIEGO GARCIA FLEET MOORINGS INSPECTION REPORT(U) NAVAL 1/1
FACILITIES ENGINEERING COMMAND WASHINGTON DC CHESAPEAKE
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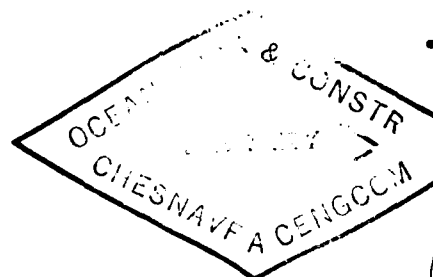
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DIEGO GARCIA FLEET MOORINGS INSPECTION REPORT

FPO-1-82(21)

OCEAN ENGINEERING
AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, DC 20374

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This inspection completion report is an evaluation of 13 fleet moorings located in the lagoon, on the atoll of Diego Garcia. This information is based on the underwater inspection of these moorings by CHESNAVFACENGCOM using UCT-2 divers during the period 12-31 May 1982. (Con't)

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The results of this inspection revealed that only one of the moorings required downgrading. Overall, the cathodic protection systems are effective when intact. Comments concerning the specific condition of each mooring buoy and its legs are included as well as recommendations for mooring repairs.

ABSTRACT

This inspection completion report is an evaluation of 13 fleet moorings located in the lagoon, on the atoll of Diego Garcia. This information is based on the underwater inspection of these moorings by CHESNAVFAC-ENGCOM using UCT-2 divers during the period 12-31 May 1982.

The results of this inspection revealed that only one of the moorings required downgrading. Overall, the cathodic protection systems are effective when intact. Comments concerning the specific condition of each mooring buoy and its legs are included as well as recommendations for mooring repairs.

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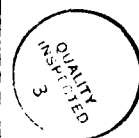


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1.0 INTRODUCTION

1.1 Background

Under the COMNAVFACENGCOM Fleet Mooring Maintenance (FMM) Program, CHESNAVFACENGCOM has been assigned the responsibility to plan and conduct periodic diver inspections of all fleet moorings worldwide. In carrying out this responsibility, CHESNAVFACENGCOM designated an Engineer-in-Charge (EIC) to provide inspection planning and on-site technical direction for the underwater inspection of fleet moorings in Diego Garcia, B.I.O.T. (see Figures 1 and 2). The actual underwater portion of the inspection was performed by divers of Underwater Construction Team Two (UCT-2) which was tasked to support the EIC. A total of 13 fleet moorings are located in the lagoon. Two are located just north and south of the POL pier (see Figure 3), and are classified as mooring dolphins. The remaining 11 fleet moorings were emplaced for use by ships of the Rapid Deployment Force and other Naval vessels (see Figure 4).

1.2 Mooring Historical Data

During April and May of 1980, two Buoy Dolphin Systems were installed in Diego Garcia as part of the POL Pier Project. The POL pier is a platform 40 feet wide by 550 feet long and is connected by a trestle to the shore at its southeasterly end. The two Buoy Dolphins serve the purpose of securing bow and stern lines of large classes of ships and are located at the two ends of the pier approximately 175 feet from the edge of the pier and set back 60 feet (inshore) from the pier face. Each of the Buoy Dolphin Systems consists of a modified MARK II Peg Top Buoy, five chain legs, sinkers, and propellant embedment anchors.

On 17 March 1981, the installation of eleven fleet moorings in the lagoon at Diego Garcia was completed. These moorings were installed in response to new Navy requirements for support of the Indian Ocean Battle Group. The eleven moorings consist of four different classes of moorings which are comprised of seventeen buoy systems. Each of these buoy systems is cathodically protected with zinc anodes and wire rope continuity cable.

2.0 GENERAL INSPECTION OBJECTIVES

The primary purpose of this inspection was to visually check the continuity of the installed cathodic protection systems and, through the use of underwater voltmeters, determine the electrical potential provided by each of these systems to support the protection of its moorings. In addition, an inspection was conducted of the chain, chain connecting links, and ground rings in order to determine the amount, if any, of wear and/or corrosion suffered by these mooring materials during their one year of fleet usage. Still photographs were taken of selected portions of each mooring system and of all damaged or abnormal conditions noted.

3.0 INSPECTION PROCEDURES

The inspection of each of the moorings was conducted as follows:

- 3.1 Buoy:** The above water portion of each buoy was visually observed in order to determine its general condition. Physical damage such as breaks, dents, or listing (which may indicate leakage) was noted and photographed. The paint was checked for cracking, chipping, or peeling. Topside jewelry and hatches were examined for worn or broken material, and the extent of rusting recorded and photographed. The upper fender system was checked for integrity, deterioration, and secure connection to the buoy.

In a similar manner, the submerged portion of each buoy was inspected by divers. The thickness of marine growth was recorded and a one foot square area cleaned of growth and the condition

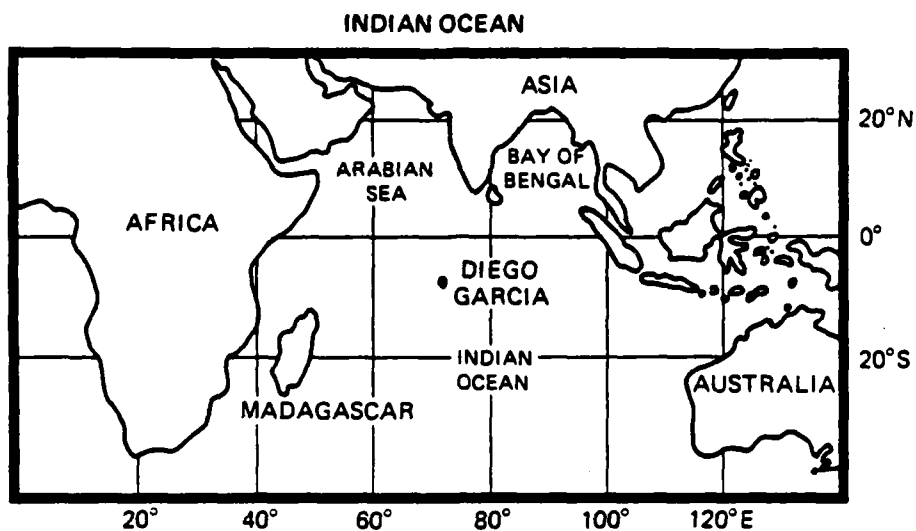


FIGURE 1. INDIAN OCEAN

DIEGO GARCIA

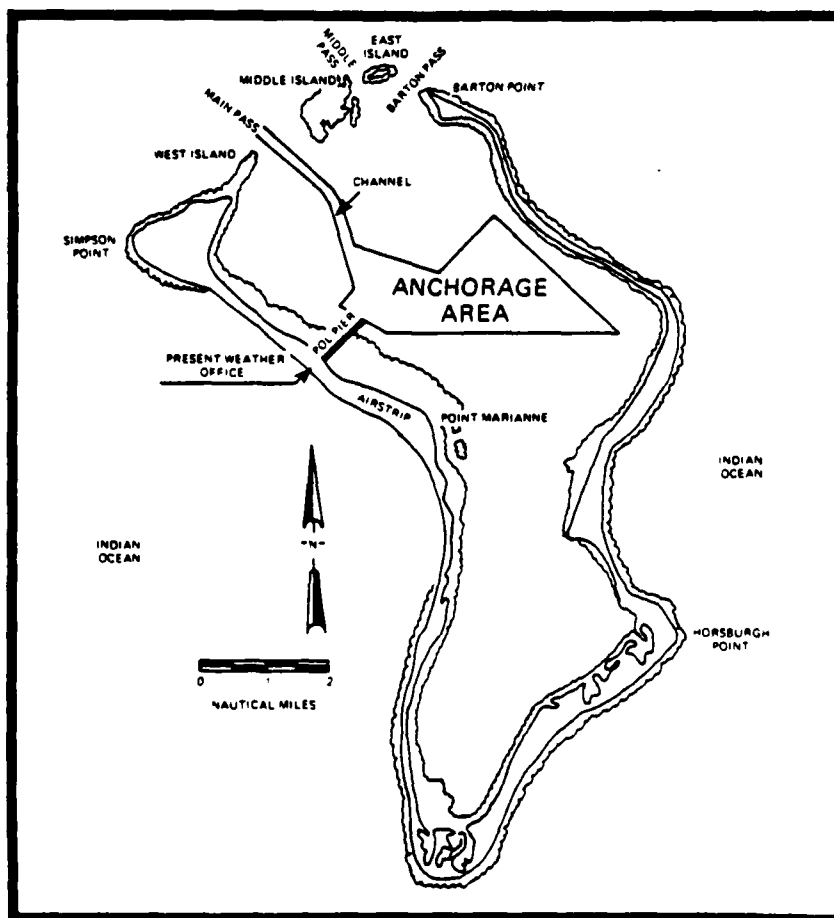


FIGURE 2. DIEGO GARCIA

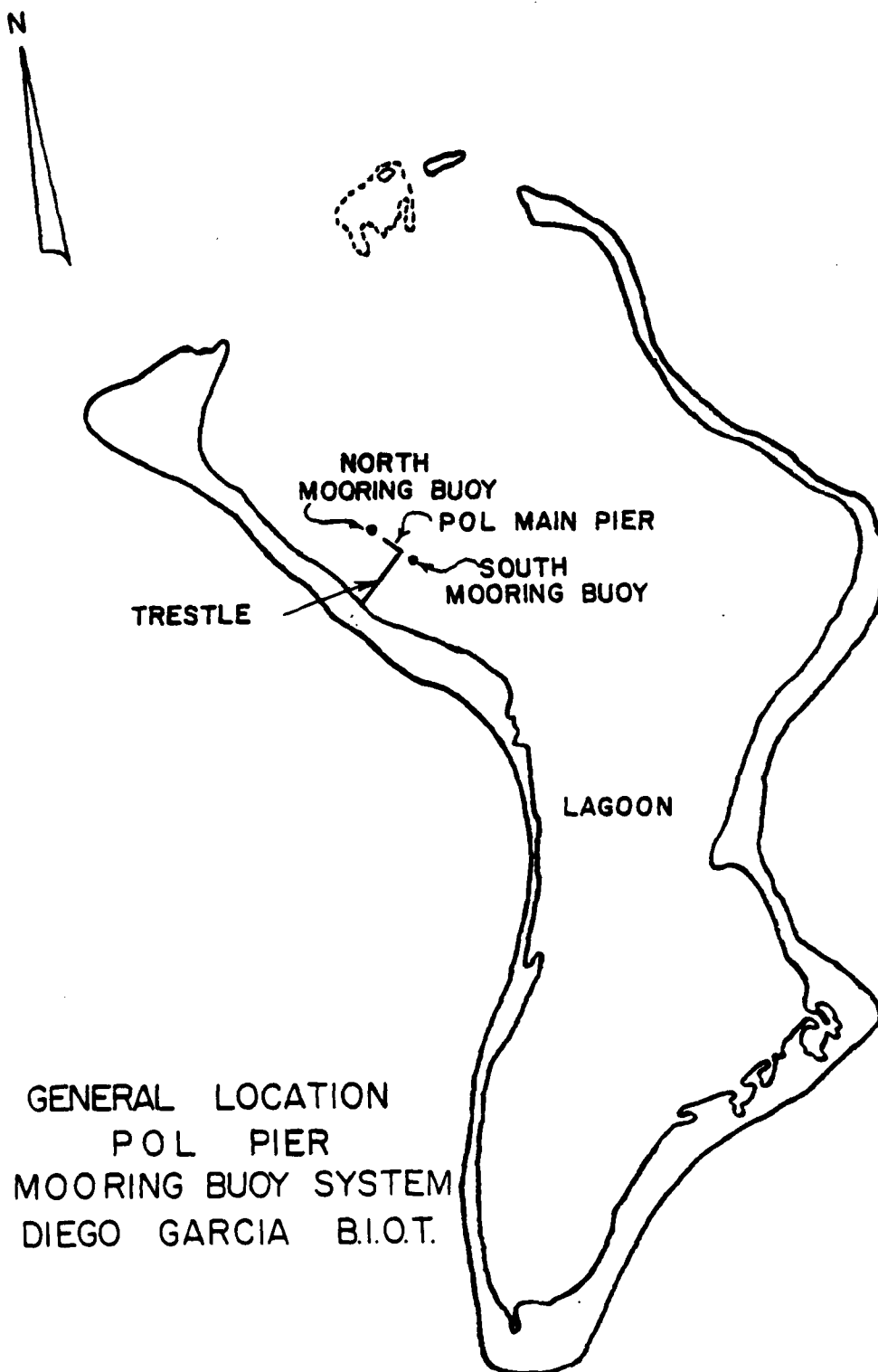


FIGURE 3. GENERAL LOCATION OF POL PIER

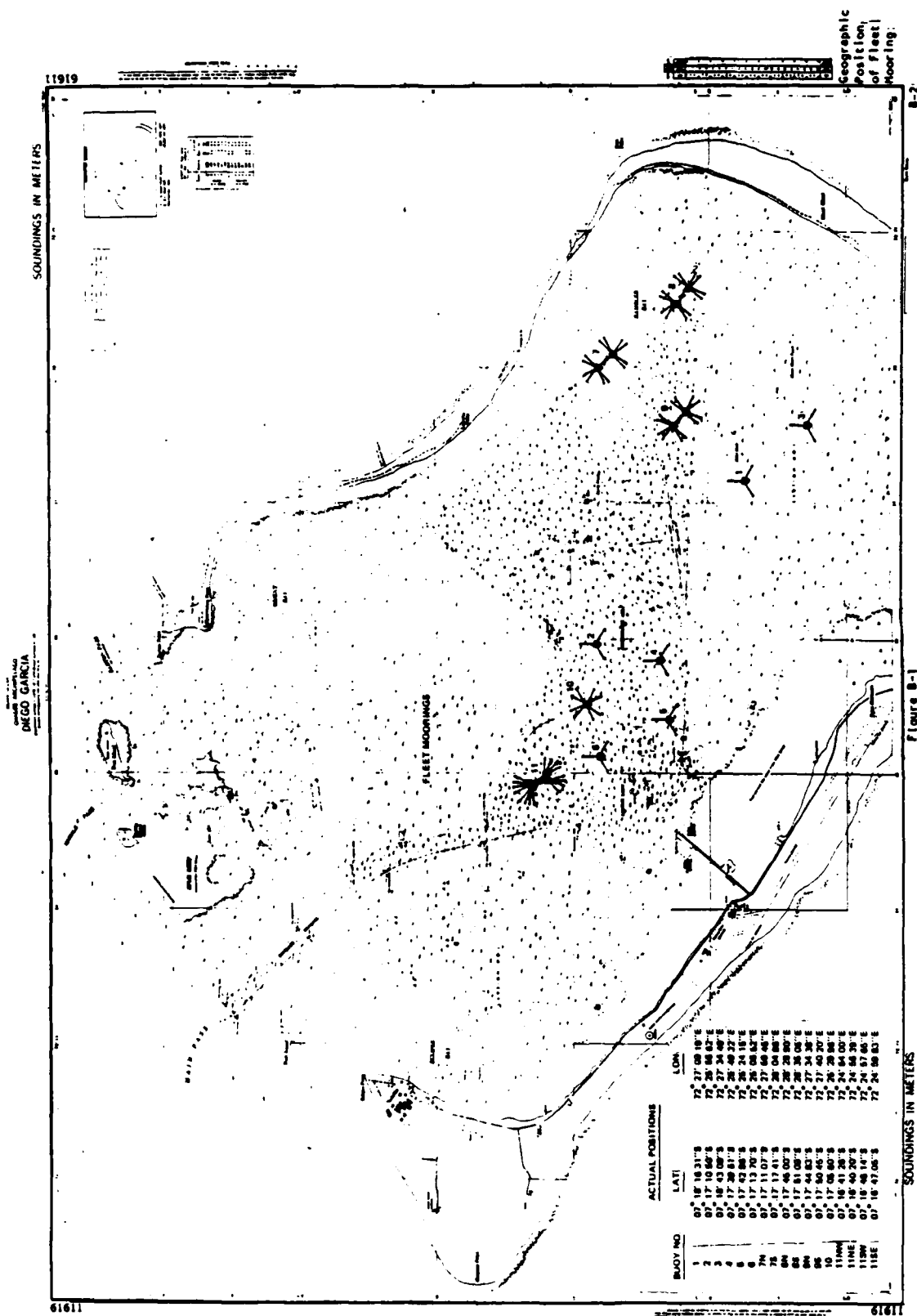


FIGURE 4. GEOGRAPHIC POSITION OF FLEET MOORING

of the paint observed. There are 150 pound anodes attached to the lower portion of each buoy. Each of these anodes was inspected for condition, erosion, and proper connection to the buoy brackets. The dimensions of one anode was recorded, and an underwater voltmeter was then used to probe the buoy bottom in three areas, and the resulting electrical potential readings were recorded. The divers then probed one of the links in the buoy bottom jewelry and recorded the reading.

3.2 Buoy Bottom Jewelry: (Excluding Moorings 1-6). Divers inspected the equalizers and checked the chain passing through them for excessive wear. The underwater voltmeter was used to probe the equalizers and at least one link either side of the chain passing through it and the results recorded.

3.3 Riser: (Includes Moorings 1-6 and Mooring Dolphins only). The divers swam down the riser chain to the ground ring. Any corrosion noted was recorded as well as the location along the riser.

The divers probed the riser chain with the voltmeter and recorded the potential readings. In addition, during the swim down the riser, divers inspected the swivel.

3.4 Ground Ring: (Includes Moorings 1-6 and Mooring Dolphins only). The divers closely viewed the ground ring and checked it for any signs of abnormal wear or corrosion. The ground ring was probed, and the potential recorded.

3.5 Ground Legs: Each of the ground legs was designed to have one 250 pound anode installed per shot of chain (90 feet). Divers swam down each ground leg and checked the integrity and secureness of the continuity cable, the condition of each anode, and took chain potential readings and recorded them. Any breaks in or looseness of the cable and the location of these deficiencies was recorded. Each of the anodes was examined for uniform erosion. Any uneven anode erosion was reported and photographed. If an anode was damaged, hanging loose from the continuity cable, or missing, this fact was also recorded.

Upon reaching the end of the chain in each ground leg, divers inspected the swage fittings, pins, and retainers connecting the chain and the 2-1/4 inch anchor pendant which leads to the anchor. The divers then swam the anchor pendant until it disappeared into the bottom checking for kinks, breaks, wear, or unravelling of the pendant.

3.6 Backstay Leg: A similar inspection was conducted of each single backstay leg. Each of these legs is cathodically protected with wire rope continuity cable and 250 pound anodes (one per shot of chain). The integrity of the continuity cable and the conditions of the anodes, sinker shackle, swivel, and anchor pendant were inspected in the same manner as those in the ground legs. Again, an underwater voltmeter was used to probe each backstay leg, and the readings were recorded.

4.0 INSPECTION SUMMARY

4.1 Findings

The Diego Garcia fleet mooring inspection team, comprised of a CHESNAVFACENGCOM Engineer and ten UCT-2 divers, were on island from the 12th to the 31st of May 1982. During this period, the team inspected the 13 moorings consisting of 19 buoy systems and 98 ground legs and completed 20

maintenance actions to repair minor discrepancies noted during the inspection. The data the divers accumulated indicate the following:

- The chain assemblies are in good condition primarily due to the installed cathodic protection systems. The accepted value of adequate cathodic protection is voltage readings between $-0.850V$ and $-0.950V$. All of the chain links and fittings measured were greater than 90% of the original diameter.
- In general, the cathodic protection systems were found to be in satisfactory condition with most underwater voltage readings within anticipated tolerances. However, wire rope continuity cables were found to be frayed and broken in seven instances, reportedly installed zinc anodes were either missing from the ground legs or possibly buried in the bottom.
- The paint on the upper (out-of-the-water) portions of all buoys is uniformly poor with light to heavy rusting. The worst buoys are Buoy 8S which is badly rusted and the four buoys in Fleet Mooring II which have heavy rusting and pitting of shackles and other topside mooring material.
- Twenty two of the 98 ground legs inspected (22%) appear to have excess chain on the bottom. Eleven of these legs loop over themselves or adjacent legs. (This condition will be eliminated once the mooring is used and put under load.)
- The wooden fenders on three of the 17 buoys are damaged and in need of repair.
- Three of the 5K concrete clump sinkers are missing and could not be visually located.
- Due to the quantity of observed marine growth within swivels and equalizers, it is readily apparent that these moorings have not been utilized.
- Some of the ground leg chain in the POL Pier's northern buoy dolphin are worn down to between 80 and 90 percent of original wire diameter.
- One of the legs of the southern buoy dolphin was measured to be less than 80 percent of its original wire diameter.

Specific information concerning each of the Diego Garcia buoy systems and ground legs is contained in the appendices.

5.0 MOORING INSPECTION COMMENTS AND RECOMMENDATIONS

As a result of an evaluation of the data gathered during the inspection, the following comments and recommendations are pertinent:

- The obvious lack of movement of swivels and equalizers provide strong evidence that the 11 fleet moorings installed during FY81 are either not being utilized at all or are being used minimally.
- Of the 13 moorings inspected, the mooring material installed in the 11 newer ones installed last year showed little or no signs of underwater wear or corrosion.
- With the exception of a few continuity cable breaks and missing anodes, some of which were subsequently repaired and replaced by UCT-2 divers, the cathodic protection systems installed in these moorings appear to be operating as designed.

- The material condition of the upper portions of the 17 buoys installed a year ago varied from poor to unsatisfactory. It is difficult to understand how in-air sections of these buoys could deteriorate so rapidly in a short period of time. However, corrective actions to repair/refurbish these buoys must be instituted without delay. This recommendation is most important.
- The inspection of the 13 mooring and 98 ground legs required 98 dives, or 53.47 hours of diving time. The actual inspection of the moorings took 46.35 hours and 7.12 hours for repairs (see Table 1).
- Once the moorings are used and mooring loads due to wind action on the ship are applied to the ground legs, the slack in these legs will be removed and the legs straightened.
- The southern buoy dolphin is unsatisfactory for fleet use as evidenced by its less than 80 percent leg chain diameters. Since both the northern and southern POL Pier moorings are not designed for large gross loads and are used only as secondary support to the prime lines securing a ship to the POL Pier, restriction on the use of these buoys could be waived by the responsible command.
- The underwater repairs by UCT-2 divers were on the cargo bow/stern, tender free swinging, and tender bow/stern moorings (see Table 2 for details).

6.0 RECOMMENDED CORRECTIVE ACTION

Due to the deteriorated condition of the mooring buoys, it is recommended that the upper portion of each buoy be scraped, cleaned, and properly repainted, using specified/authorized materials, as soon as practical. Delays in refurbishing these buoys can only lead to further deterioration. Excessive delays in maintenance actions could lead to the requirement for replacement of the buoys. Both the northern and southern mooring dolphins should be overhauled by removing from the water and replacing all deteriorated chain and connecting hardware.

TABLE 1

DIEGO GARCIA DIVING DATA

Total number of dives:	98
Total hours of diving time:	53:47
Number of dives for inspection:	73 (2 diver sets)
Number of dives for repairs:	25 (2 diver sets)
Hours of diving time for inspection:	46:35
Hours of diving time for repairs:	7:12
Number of Moorings inspected:	13
Number of Mooring legs inspected:	98
Number of Mooring system repairs:	20
Installed Anodes:	16
Connected Jumpers:	3
Removed Stoppers:	2

TABLE 2

DIEGO GARCIA REPAIRS

(5/25/82 - 5/31/82)

BUOY	LEG	REPAIRS
7S	A1	Installed continuity wire jumper at 90 feet
	B1	Removed stopper at 45 feet
7N	A1	Installed anode on last shot of chain
	B2	Installed anode on last shot of chain
8N	A1	Installed anode on last shot of chain
	A2	Installed anode on last shot of chain
	B1	Installed anode on last shot of chain
	C1	Installed anode on last shot of chain
	C2	Installed anode on last shot of chain
9S	A1	Installed anode on last shot of chain
	A2	Installed anode on last shot of chain
	B1	Installed anode on last shot of chain
	B2	Installed anode on last shot of chain
10	C1	Repaired anode wire at 85 feet
	D1	Installed continuity wire jumper between 1st and 2nd anodes
11SW	B2	Installed anode on last shot of chain
11SE	A1	Installed anode on last shot of chain
	A2	Installed anode on last shot of chain
	B1	Installed anode on last shot of chain
	B2	Installed anode on last shot of chain

APPENDIX A-1

Cargo Free Swing Moorings: There are six of this type mooring installed in the lagoon at Diego Garcia (Fleet Moorings 1 through 6). Each of these moorings is a riser type and includes a MK11 Peg Top Buoy, a half shot of riser chain, a ground ring, three 540 foot ground legs, and three propellant embedment anchors. The buoy and ground legs of each of these moorings are cathodically protected with zinc anodes and wire rope continuity cable systems. Figure A-1 is an isometric drawing of each of these mooring systems, and Figure A-2 depicts the regions that were inspected on each of the risers and ground legs.

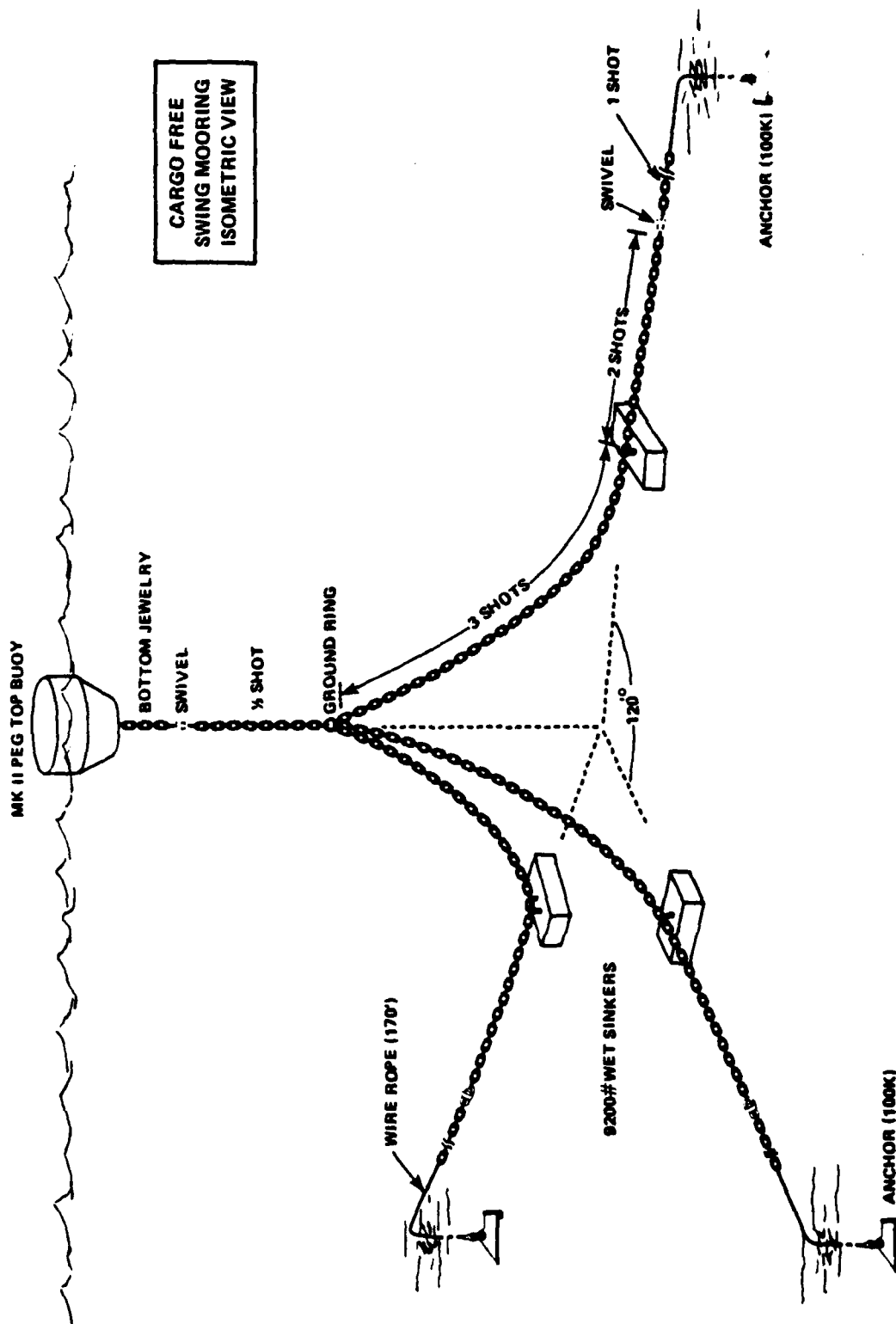


FIGURE A-1. CARGO FREE SWINGING MOORING



FIGURE A-2. CARGO FREE SWINGING MOORING GROUND LEG

BUOY 1

Buoy

Anodes are in good condition. The top fender, rub rail, and jewelry are in satisfactory condition with some slight rusting of hardware.

Riser

The ground ring was at a depth of 60 feet and approximately 20 feet off the silty bottom.

Ground Leg A

The anodes were clean and square with a continuous continuity wire.

Ground Leg B

The anodes were in satisfactory condition, and the continuity wire was intact.

Ground Leg C

Eight links of chain are piled up where the leg hits the bottom. From there, one shot of chain loops over itself several times forming a figure eight pattern. No anodes were seen along this stretch of chain. Moderate marine growth was evident. Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

Recommended Maintenance Action

Buoy should be refurbished.

UNDERWATER VOLTAGES (VOLTS)

BUOY 1

	RISER		
	BUOY		
	REGION I		
	LEGs		
	A	B	C
REGION II	-.980	-.925	-.943
REGION III	-.981	-.937	-.990 -.989
REGION IV	①	-.939 -.930	-.982
REGION V	-.981	-.937 -.941	-1.001
REGION VI	-.980	-.924	-.985
REGION VII	①	-.939	-.971
ANCHOR PENDANT	-.980	-.911	-.982

① > -.950 mV

BUOY 2

Buoy

The buoy top fender is loose and needs repair. Marine growth is minimal with slight topside rusting.

Riser

The chain links below the swivel had slight rusting between links.

Ground Leg A

The clump was in satisfactory condition. The anodes along this leg had been reduced by approximately 1/2". A crater 6 feet wide and 2 feet deep was observed where the anchor pendant entered the sea floor.

Ground Leg B

This leg loops out under leg C before reaching the clump. The clump itself is resting on the chain. The anode past the swivel was missing. The remaining anodes had even pitting. A crater of 5 foot diameter and 3/4 foot depth was observed at the point where the anchor pendant entered the sea floor.

Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anode.

Ground Leg C

This leg is positioned on an incline. The deepest section (92 feet) is between the ground ring and the clump. The incline levels off at 80 feet, approximately 1 shot past the clump. The continuity wire is intact along the leg. The anode's surface is moderately reduced.

Recommended Maintenance Action

Buoy should be refurbished.

UNDERWATER VOLTAGES (VOLTS)

BUOY 2

RISER				
BUOY	-1.000			
REGION I	-1.002			
	- .993			
		LEGS		
		A	B	C
REGION II	- .979	- .968	- .968	- .981
REGION III	- .981	- .985	- .993	- .978
	- .982	- .982	- .973	
REGION IV	- .975	- .984	- .982	
REGION V	- .981	- .985	- .980	
REGION VI	- .985	- .989	- .971	
REGION VII	- .961	①	- .976	
ANCHOR PENDANT	①	①	- .972	

① > - .950 mV

BUOY 3

Buoy

The anodes on the buoy had a moderate covering of marine growth. Buoy topside and hardware has slight rusting. Fenders are in satisfactory condition.

Riser

The riser assembly was covered with soft coral.

Ground Leg A

This leg is buried in the silty bottom approximately 30 feet past the ground ring. This could be due to dredging in the area. The anode had a 1/2" residue on its surface.

Ground Leg B

Thirty feet below the ground ring the chain was buried in silt.

Ground Leg C

Excess chain was located on bottom before leg was buried in the silt at 85 feet.

Recommended Maintenance Action

Buoy should be refurbished.

UNDERWATER VOLTAGES (VOLTS)

BUOY 3

	RISER		
	BUOY		
	REGION I		
	LEGS		
	A	B	C
REGION II	- .988	- .983 - .858	-1.004
REGION III	①	- .907	- .992
REGION IV	①	①	①
REGION V	①	①	①
REGION VI	①	①	①
REGION VII	①	①	①
ANCHOR PENDANT	①	①	①

① Buried, not able to take measurements

BUOY 4

Buoy

Moderate surface rust on top of buoy as well as on manhole.

The anodes on the buoy are in satisfactory condition with a 1/4 inch residue on the surface. There is approximately 1/2 inch of marine growth on lower section of buoy.

Riser

The riser has moderate marine growth.

Ground Leg A

Excess chain was located on the bottom. The clump is in satisfactory condition. The anodes edges showed signs of slight reduction.

Ground Leg B

Fifteen feet of chain forms a loop on the silty bottom. Anodes are moderately reduced.

Ground Leg C

Anodes are in satisfactory condition. Chain is in tension and suspended up to the clump. The swivel and remaining chain are buried.

Recommended Maintenance Action

Buoy should be refurbished.

UNDERWATER VOLTAGES (VOLTS)

BUOY 4

RISER				
BUOY	- .982			
	- .983			
REGION I	- .988			
	- .981			
	- .980			
		LEGS		
		A	B	C
REGION II	- .986	- .967	①	
REGION III	- .996	- .967	- .986	
		- .972		
		- .968		
REGION IV	- .997	-1.000	-1.001	
		- .990		
REGION V	- .999	-1.015	-1.002	
REGION VI	- .984	- .990	①	
REGION VII	-1.002	-1.000	②	
ANCHOR PENDANT	①	①	②	

① > -.950 mV

② Buried, not able to take measurements

BUOY 5

Buoy

Topside moorings cables are fouled around the riser. Light rusting above top fender was reported.

Riser

There is moderate marine growth on the riser.

Ground Leg A

Leg is buried from above swivel down past anchor pendant.

Ground Leg B

Chain snakes back and forth on bottom below the ground ring. The links are buried in the silt after the clump.

Ground Leg C

Cables wrapped around the leg created a hazard to divers, preventing a close inspection.

Recommended Maintenance Action

Buoy should be refurbished.

UNDERWATER VOLTAGES (VOLTS)

BUOY 5

RISER				
BUOY	-.965			
REGION I	-.960			
	-.953			
		LEGS		
		A	B	C
REGION II	-.976	-.926 -.700	②	
REGION III	-.980 -.989	-.917	②	
REGION IV	-.989 -.992	-.990	①	
REGION V	-1.003	①	①	
REGION VI	-1.006	①	①	
REGION VII	①	①	①	
ANCHOR PENDANT	①	①	①	

① Buried, not able to take measurements

② Cable wrapped around chain is hazardous to divers, not able to take measurements

BUOY 6

Buoy

Moderate rust on topside with some flaking on hardware.

Riser

Riser had moderate marine growth.

Ground Leg A

Chain forms a large loop with the first shot when it hits bottom. Anode on the second shot has 1/2" of corner reduced. The swivel and anchor pendant are covered by silt.

Ground Leg B

Chain makes right angle turn as it hits bottom. The links near bottom are shiny, possibly due to abrasive action with the sea floor. The anodes are reduced by about 1/2 inch.

Ground Leg C

The clump is resting on its longer side. The anodes are square and in satisfactory condition. Divers reported a 10 foot diameter crater where the anchor pendant enters the bottom.

Recommended Maintenance Action

Buoy should be refurbished.

**UNDERWATER VOLTAGES
(VOLTS)**

BUOY 6

	RISER		
BUOY	- .981 - .980		
REGION I	- .975 - .918 - .974		
	LEGS		
	A	B	C
REGION II	- .996	- .977 - .986	- .944
REGION III	- .917	- .987	- .990
REGION IV	-1.004	-1.004	- .982
REGION V	-1.010	- .987	- .989
REGION VI	-1.010	-1.003	- .979
REGION VII	-1.015	-1.007	- .975 - .983
ANCHOR PENDANT	①	①	- .972

① $> -950 \text{ mV}$

APPENDIX A-2

Cargo Bow/Stern Moorings: There are three of these moorings installed, each consisting of two buoy systems (Fleet Moorings 7N, 7S, 8N, 8S, 9N, and 9S). Each buoy system consists of a 16 foot diameter Telephone Buoy, three 2-3/4 inch equalizers attached to three of the four buoy pad eyes, three ground leg pairs consisting of seven shots of chain (630') per leg pair, and six 150K propellant embedment anchors. A seven shot backstay leg with its embedment anchor is attached directly to the buoy's fourth pad eye. The buoy, backstay leg, and the ground legs contain cathodic protection systems. Figure A-3 is an isometric drawing of each of these six buoy systems. Figures A-4 and A-5 depict the regions that were inspected.

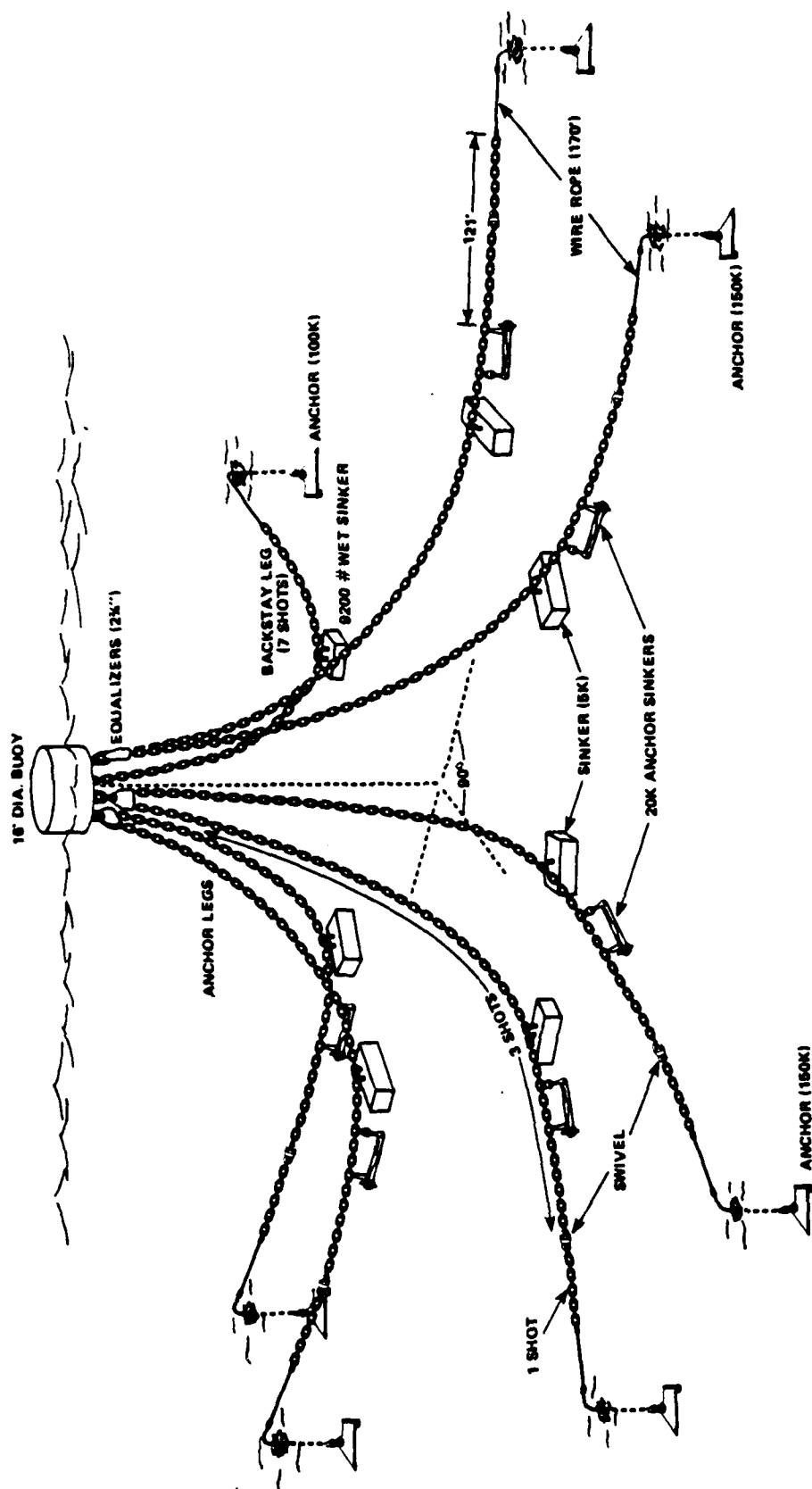


FIGURE A-3. CARGO BOW/STERN MOORING

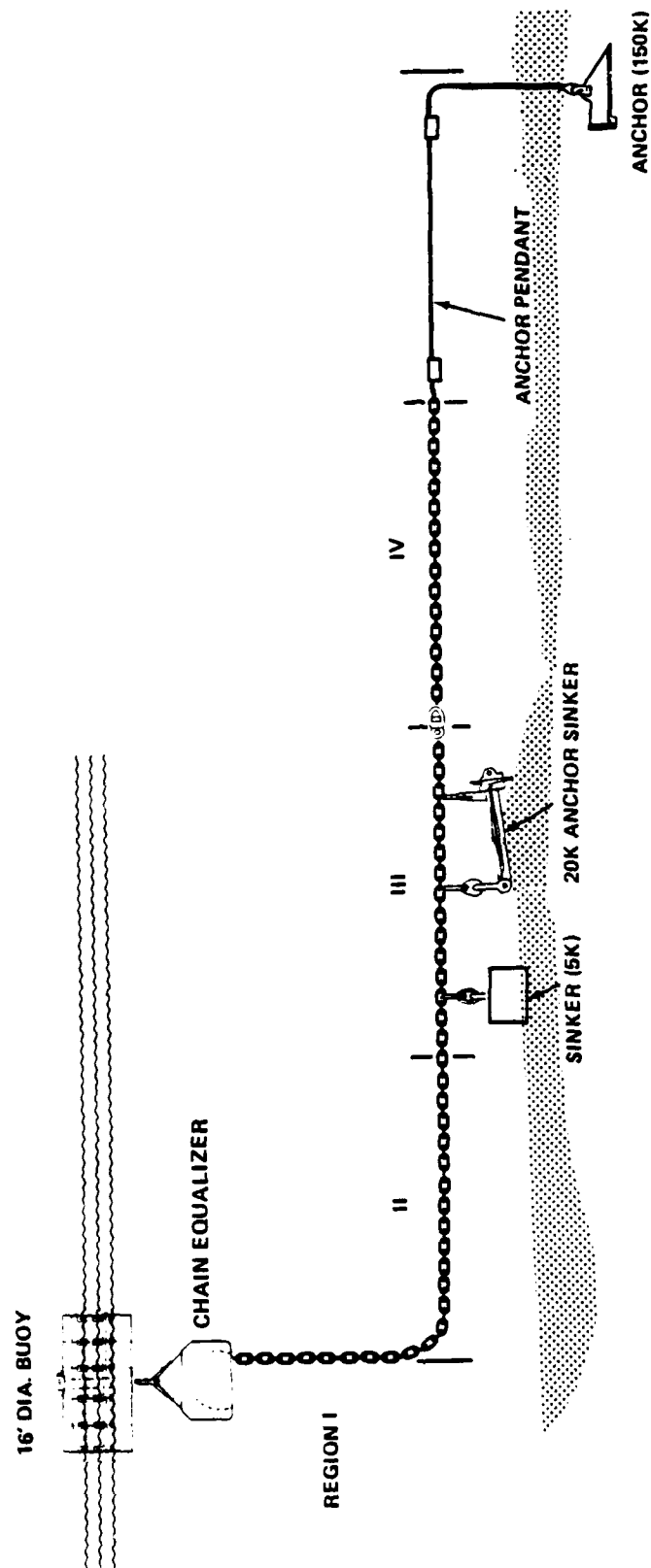


FIGURE A-4. CARGO BOW/STERN MOORING GROUND LEG

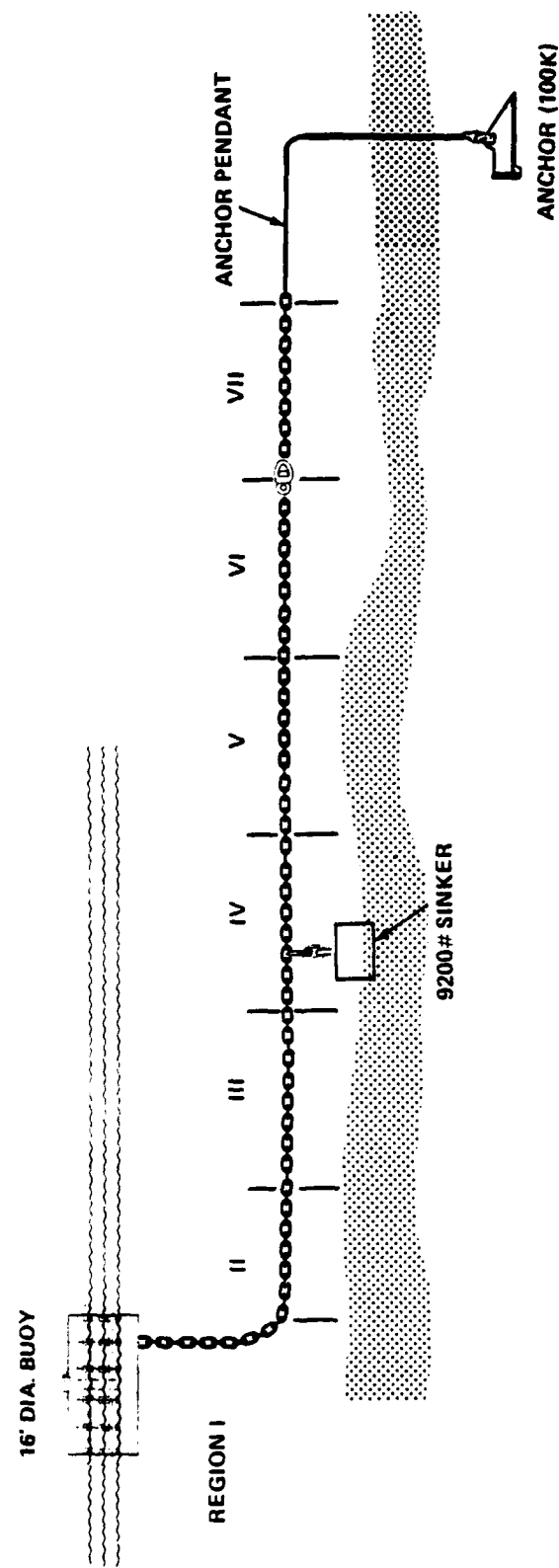


FIGURE A-5. CARGO BOW/STERN MOORING BACKSTAY LEG

BUOY 7S

Buoy

Topside deck has light rusting. Fender is in satisfactory condition, but fender brackets are moderately rusting.

Leg A1

The equalizer is at a depth of 30 feet. As the chain hits the silty bottom at 90 feet, the continuity wire was frayed and broken. The wire was subsequently repaired.

The divers reported that the 5K sinker was missing from this leg along with an anode following the anchor clump.

Leg A2

The equalizer has heavy growth and shows no sign of chain movement. The 5K and 20K sinkers are in satisfactory condition.

Leg B1

The chain loops over itself after reaching the bottom at 85 feet. A swivel was located 10 feet before the clump.

The shank of the anchor is resting on the clump with the flukes setting on the bottom.

Divers removed an existing chain stopper at 45 feet below the equalizer.

Leg B2

The chain reaches bottom at 85 feet. At this point it loops around before reaching the clump.

Leg C1

Leg C2 loops over C1 before continuing down to the anchor.

The sinkers and swivel are in satisfactory condition.

Leg C2

The 5K and 20K sinkers are in satisfactory condition.

Backstay Leg

The chain has light marine growth on it. As the chain reaches bottom, it forms a loop before continuing to the anchor.

Two anodes are missing, one below the buoy and the other before the clump.

Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

Recommended Maintenance Action

Buoy should be refurbished.

UNDERWATER VOLTAGES (VOLTS)

BUOY 7S

GROUND LEG						BACKSTAY LEG	
LOCATION	A1	A2	B1	B2	C1	C2	LOCATION
BUOY	①	①	①	①	①	①	BUOY ①
REGION I	- .964 - .964 - .972	- .964 - .984 - .994	- .967 - .959	- .965 - .820	- .964 - .923	- .967 - .971 - .827	REGION I - .884
REGION II	- .991 - 1.001	- 1.003	- .983	- .818	- .964 - .951	- .928 - .930	REGION II - .890
REGION III	- .984	- .969 - .877	- .975	- .922	- .952 - .965	- .949 - .968	REGION III - .954
REGION IV	- 1.005	- .975	- .928	- .995	- .957	- .671 - .953 - .925	REGION IV - .990
ANCHOR PENDANT	- .916	- .805	- .707 - .825 - .734	- .701	- .953	- .956	REGION V - 1.004 - .977
							REGION VI - 1.015 - 1.012
							REGION VII - .992
							ANCHOR PENDANT ②

① > -950 mV

② Buried, not able to take measurements

BUOY 7N

Buoy

One inch of marine growth was reported on the bottom of the buoy. Topside has light rusting.

Leg A1

The chain and equalizer have accumulated 1/2 inch of marine growth.

Two anodes are missing, one below the buoy, another below the 20K sinker.*

The continuity wire only runs down to the clump. Beyond this point there was no cathodic protection. Divers repaired the cathodic protection system by installing an anode and continuity wire.

Leg A2

The equalizer showed no signs of chain movement.

The 5K and 20K sinkers were in satisfactory condition. No continuity wire or anodes extend beyond the clump.*

Leg B1

The chain reached bottom at a depth of 85 feet. Leg B1 and B2 loop over each other on the bottom (if tension is put on the legs they would straighten out). Divers reported no 5K sinker on the leg.

Leg B2

This leg also reached bottom at 85 feet and was missing the 5K sinker. The swivel and jewelry were all in satisfactory condition.

Divers installed an anode on the last shot of chain.

Leg C1

The equalizer has moderate growth and no movement.

The chain hits bottom at 87 feet before making a loop over itself. The anodes showed signs of moderate reduction.

Leg C2

The first anode from the surface was disconnected and laying on the bottom. The anode past the 20K anchor was also missing.*

Backstay Leg D

All three anodes before the clump are missing from this leg. The remaining anodes were moderately reduced.*

Recommended Maintenance Action

Buoy should be refurbished.

*Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

UNDERWATER VOLTAGES (VOLTS)

BUOY 7N

GROUND LEG						BACKSTAY LEG	
LOCATION	A1	A2	B1	B2	C1	C2	LOCATION
BUOY	-.962	-.962	-.965	-.962	-.962	-.962	BUOY
REGION I	-.980	-1.000 -.985	-.977	-.979	-.975	-.969	REGION I
REGION II	-.980	-.983	-.974 -.982	-.986	-.997 -.954	-.981 -.961	REGION II
REGION III	-.950	②	-.910	-.857	-.924 -.942	-.945 -.952	REGION III
REGION IV	②	②	-.976	-.611	-.968	-.875	REGION IV
ANCHOR PENDANT	①	①	②	-.611	-.922	-.875	REGION V
							REGION VI
							REGION VII
							ANCHOR PENDANT

① Buried, not able to take measurements

② > -.950 mV

BUOY 8S

Buoy

The topside of this buoy has severe rust around the manhole.

Leg A1

The continuity wire starts at a depth of 70 feet and the chain reaches bottom at 85 feet.

One anode was missing beyond the 20K sinker.*

Leg A2

The chain reaches bottom at 85 feet. The continuity wire starts three feet off the bottom and runs to the swivel. Divers reported the anode below the 20K sinker missing but could possibly be buried.

Leg B1

The chain hits bottom at 85 feet with those links near the bottom worn shiny. The anodes are reported to be reducing evenly. The sinkers and continuity wire are in satisfactory condition. One anode is missing below the 20K sinker.*

Leg B2

The chain reaches bottom at 85 feet. The continuity wire and the sinkers are in satisfactory condition. The anode below the 20K sinker is not visible and may be buried.

Leg C1

Excess chain was located on the bottom. The continuity wire starts at a depth of 60 feet.

Leg C2

The chain reaches bottom at 85 feet. The 5K and 20K sinkers are in satisfactory condition. The anode below the 20K sinker was reported missing.*

Backstay Leg

Three anodes are missing from the leg, two right above the sinker and the first one below the buoy. The sinker, swivel and continuity wire are in satisfactory condition.*

Recommended Maintenance Action

Buoy should be refurbished.

*Since the voltate readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

UNDERWATER VOLTAGES (VOLTS)

BUOY 8S

GROUND LEG							BACKSTAY LEG	
LOCATION	A1	A2	B1	B2	C1	C2	LOCATION	D
BUOY	-.982 -.979	-.982 -.979	-.982 -.979	-.982 -.979	-.982 -.979	-.982 -.979	BUOY	-.982 -.979
REGION I	-.957	-.900 -.972 -.998	-.987	-.945 -.920 -.900	-.970 -.978 -.974	(1)	REGION I	-.980
REGION II	-.978 -.959	-.991 -.993	-.977 -.880	-.885 -.887	-.958 -.918	(1)	REGION II	-.983
REGION III	-.952 -.800	-.929 -.933 -.898	-.980 -.950 -.953	-.940 -.904	-.980 -.890	-.930	REGION III	-.986
REGION IV	-.750	-.935	-.950	-.957	-.762	-.870	REGION IV	-.994
ANCHOR PENDANT	-.720	-.935	-.931 -.935	-.951	-.764	-.760 -.660	REGION V	-.995
							REGION VI	-.985
							REGION VII	-.985
							ANCHOR PENDANT	-.985 -.985

(1) > -.950 mV

BUOY 8N

Buoy

One zinc anode was missing from the buoy (behind backstay leg). * There is light rusting around the manholes with heavy rust on fender brackets.

Leg A1

Leg A2 loops over A1. The continuity wire runs down to the swivel.

Divers installed an anode on the last shot of chain.

Leg A2

The continuity wire runs from 45 feet below the surface down to the swivel. The lack of cathodic protection beyond this point is a probable factor for the low voltage readings below the swivel.

The 5K and 20K sinkers are in satisfactory condition.

Divers installed an anode on the last shot of chain.

Leg B1

The continuity wire starts at 40 feet, and the bottom is at 83 feet. Several coral heads provide obstacles for the chain to maneuver around.

Divers installed an anode on the last shot of chain.

Leg B2

The chain hits bottom at 82 feet. The underside of the chain near the bottom has been rubbing the bottom and caused wearing of the chain. The continuity wire runs from 50 feet down, to the swivel. The 5K and 20K sinkers are in satisfactory condition.

Leg C1

Excess chain is laying on the bottom. The continuity wire runs down to the swivel and is in satisfactory condition.

Divers installed an anode on the last shot of chain.

Leg C2

The chain near the bottom (60 feet) is shiny on the underside.

Divers installed an anode on the last shot of chain.

Backstay Leg

The continuity wire runs from a depth of 40 feet down to the swivel. The first anode below the surface is missing along with the two above the sinker. The sinker was in satisfactory condition. The continuity wire runs between the anchor pendant and the swivel.*

Recommended Maintenance Action

Buoy should be refurbished.

*Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

UNDERWATER VOLTAGES (VOLTS)

BUOY 8N

GROUND LEG							BACKSTAY LEG	
LOCATION	A1	A2	B1	B2	C1	C2	LOCATION	D
BUOY	-.974	-.974	- .974	- .974	-.974	-.977 -.980	BUOY	-.976 -.981
REGION I	-.973 -.992	-.975	- .977	- .949 -1.001 - .931	-.983	-.977 -.936	REGION I	-.948
REGION II	-.916	-.985 -.988	-1.002 -1.004	-1.004	-.987 -.900	-.970 -.988	REGION II	-.986
REGION III	-.909 -.888 -.890	-.951 -.838 -.682	- .964 - .948	- .949 - .933	-.970	-.867 -.887	REGION III	-.997
REGION IV	-.575	-.632 -.675	- .634 - .629	- .921 - .631	-.634 -.640	-.889 -.650 -.700	REGION IV	-.977
ANCHOR PENDANT	-.694 -.674	-.680	①	- .820	-.700 -.685	-.704 -.736	REGION V	-.994
							REGION VI	-.993
							REGION VII	-.996
							ANCHOR PENDANT	-.995

① Buried, not able to take measurements

BUOY 9S

Buoy

The fender is missing one 4 foot section. The topside hardware has moderate rust.

Leg A1

The chain reaches bottom at 95 feet. Before the chain reaches the 5K sinker it loops around and crosses over the 20K sinker. The continuity wire is broken immediately past the 20K sinker, and the anode is hanging on the end.

Divers installed an anode on the last shot of chain.

Leg A2

The continuity wire runs down to the swivel.

Divers installed an anode on the last shot of chain.

Leg B1

Leg B2 loops over B1. The continuity wire runs down to the swivel.

Divers installed an anode on the last shot of chain.

Leg B2

The continuity wire runs down to the swivel. Two anodes are missing from the leg above the 5K sinker. These two anodes were not replaced due to satisfactory cathodic protection.

However, divers did install an anode and continuity wire on the last shot of chain.

Leg C1

The 5K sinker is partially covered with silt, and the 20K sinker is in satisfactory condition. The anchor pendant is completely buried in silt. The large amounts of silt are due to a dredge working in the area.

Leg C2

The continuity wire runs from a depth of 80 feet down to the swivel. Both sinkers are in satisfactory condition. The anode below the 20K sinker was missing.*

Backstay Leg

The continuity wire runs all the way down to the anchor pendant. Four anodes are missing from the leg. Three anodes are missing above the 5K sinker and one below.*

Recommended Maintenance Action

Buoy should be refurbished.

*Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

UNDERWATER VOLTAGES (VOLTS)

BUOY 9S

GROUND LEG						BACKSTAY LEG	
LOCATION	A1	A2	B1	B2	C1	C2	LOCATION
BUOY	(1)	(1)	(1)	(1)	(1)	(1)	BUOY
REGION I	-.954 -.943	-.947	-.983 -.970 -.990	-.900	-.978	-.987	REGION I
REGION II	-.953	-.953	-.993	-.900	-.983	-.946	REGION II
REGION III	-.973 -.915 -.711	-.900 -.884 -.800	-.942 -.947	-.962 -.950	-.960	-.919	REGION III
REGION IV	-.600 -.700	-.700	-.660 -.642 -.662	-.640 -.690	-.884	-.943 -.862	REGION IV
ANCHOR PENDANT	-.687 -.887 -.984	-.660	-.693 -.692	-.600 -.700	(2)	-.863	REGION V
							REGION VI
							REGION VII
							ANCHOR PENDANT
							- .989
							- .994
							- .993
							(1)
							- .943
							- .973
							-1.000 -1.005 -1.004

(1) > -.950 mV

(2) Buried, not able to take measurements

BUOY 9N

Buoy

Paint and fenders on buoy are in satisfactory condition with slight scaling at jewelry.

Leg A1

Both sinkers are in satisfactory condition.

Leg A2

The equalizer has moderate marine growth and no movement. One anode is missing immediately below the 20K sinker.* Both sinkers are in satisfactory condition.

Leg B1

Leg B2 loops over B1 twice before reaching bottom at 95 feet. The anode below the 20K sinker was missing.* The anodes were moderately reduced and the continuity wire continuous.

Leg B2

Divers report approximately 1/2 inch of marine growth on the chain.

Leg C1

The chain is zigzagging back and forth for 50 links before the 5K sinker. Both sinkers are in satisfactory condition.

Leg C2

The first anode below the surface is missing.* A section of chain is wrapped around the 20K sinker.

The continuity wire is intact throughout the leg.

Backstay Leg

An extra length of chain is hanging from the buoy. The chain drops straight down with the excess chain on the bottom. The 20K sinker is laying on the corner of the 5K sinker. The chain makes an S-turn before the 5K sinker.

Recommended Maintenance Action

Buoy should be refurbished.

*Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

UNDERWATER VOLTAGES (VOLTS)

BUOY 9N

GROUND LEG							BACKSTAY LEG	
LOCATION	A1	A2	B1	B2	C1	C2	LOCATION	D
BUOY	- .982 - .985	- .982 - .984	- .982 - .980	- .980	- .900	- .977	BUOY	- .985 - .981
REGION I	- .976 - .995	- .999	- .982	- .970 - .974	- .900	- .975	REGION I	- .978
REGION II	- .990 - .920	- .993	- 1.001	- .992 - .990	- .900	- .988 - .802	REGION II	- .982
REGION III	- .991	(1)	- .898 - .957	- .980 - .960	- .900	- .900 - .980	REGION III	- .973
REGION IV	- .707	- .995	- .953 - .960	- .967 - .980	- .900	- .900	REGION IV	- .982 - .975
ANCHOR PENDANT	- .779 - .780	- .818	- .878 - .876 - .900	- .962 - .960 - .970	- .900	- .900	REGION V	- .989
							REGION VI	- .984 - .992
							REGION VII	- .976 - .992
							ANCHOR PENDANT	- .980 - 1.003

(1) > - .950 mV

APPENDIX A-3

Tender Free Swing Mooring: Fleet Mooring 10 is the only mooring of this type installed at Diego Garcia. This mooring consists of a single 16 foot Telephone Buoy, four 2-3/4 inch equalizers attached to the buoy pad eyes, four ground leg pairs consisting of seven shots of chain each, and eight 150K, PEAs. The design of this mooring is identical to that of each of the Cargo Bow/Stern buoy systems with the exception that this mooring has a fourth leg pair instead of a backstay leg. Figure A-6 is an isometric drawing of FM 10 while Figure A-7 depicts the regions that were inspected on each leg of the mooring.

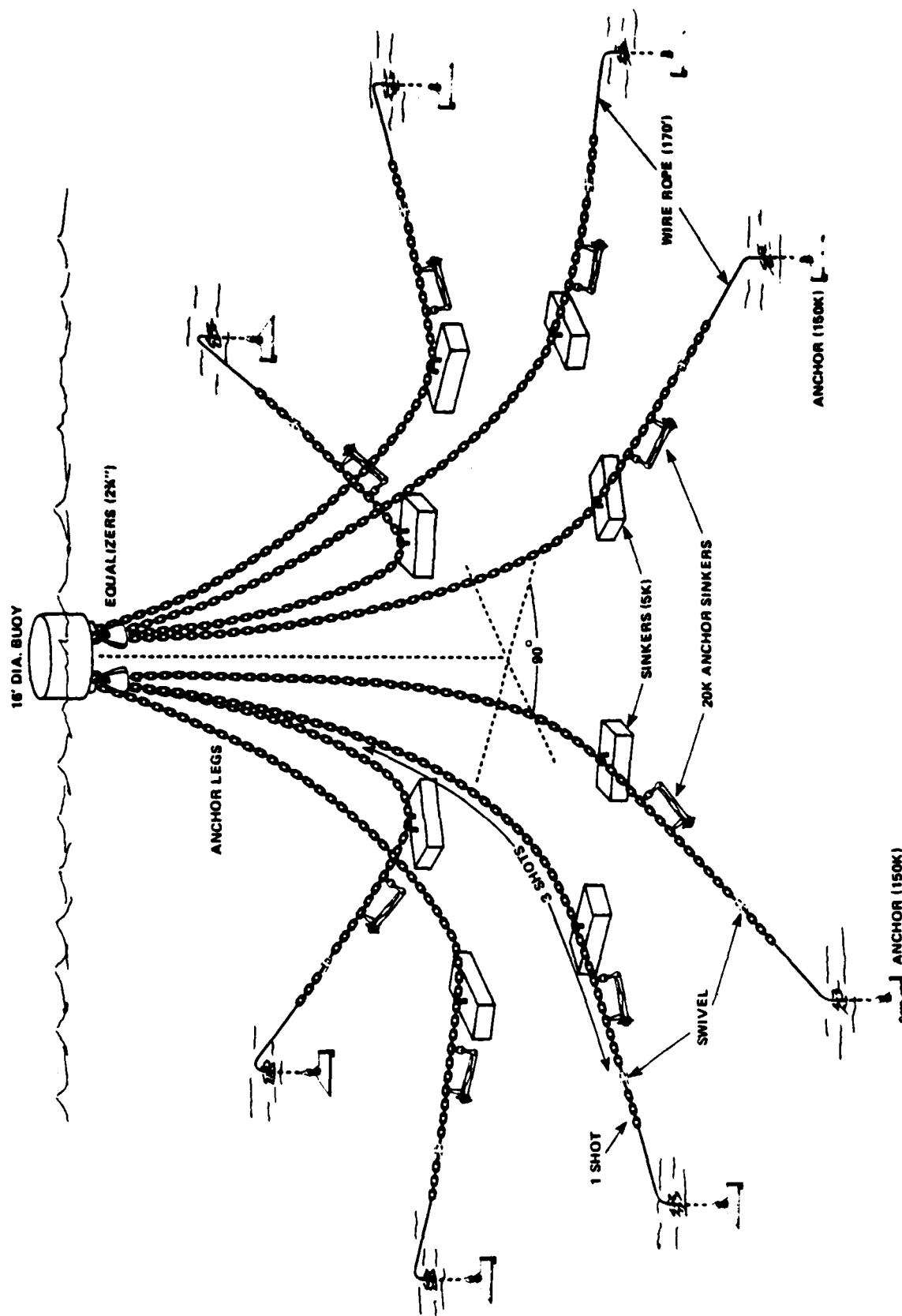


FIGURE A-6. TENDER FREE SWINGING MOORING

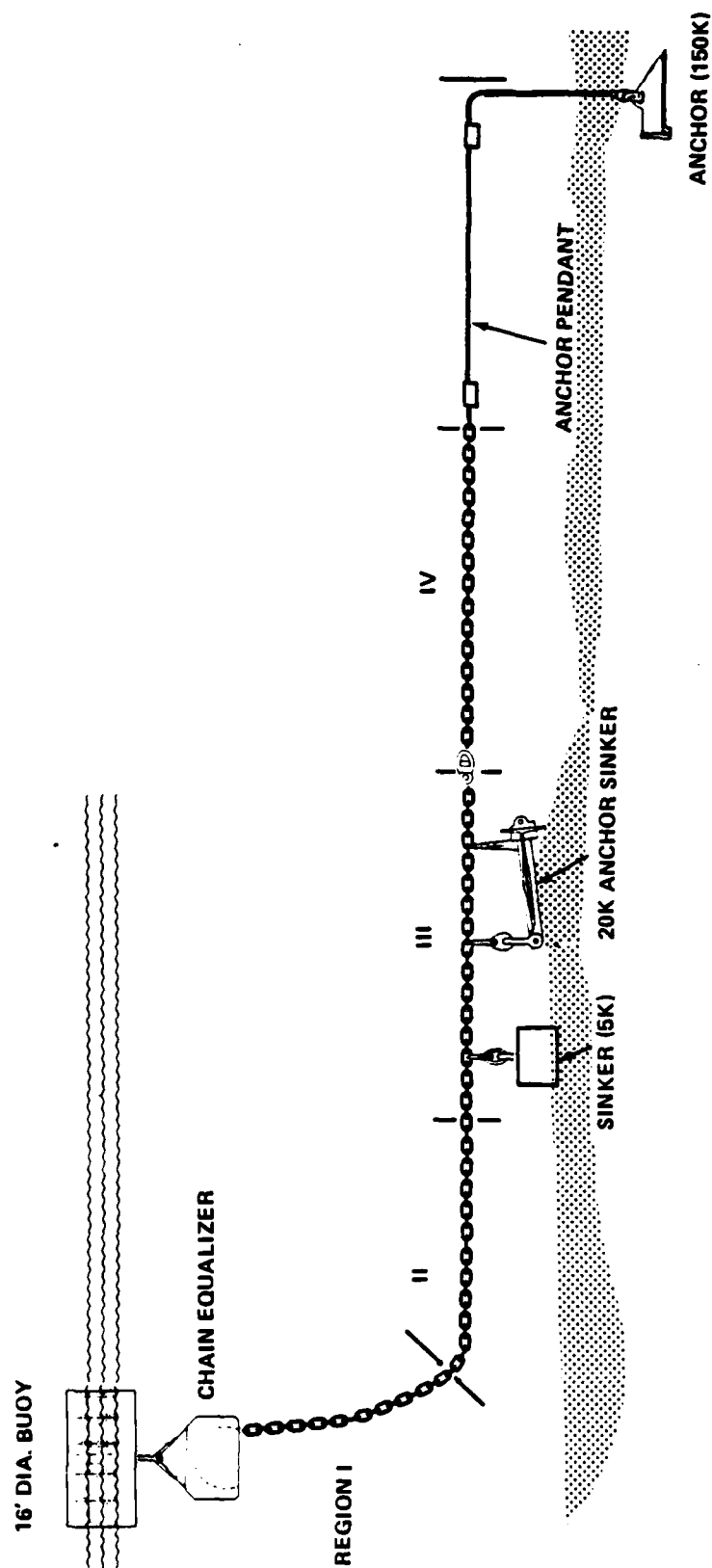


FIGURE A-7. TENDER FREE SWINGING MOORING GROUND LEG

BUOY 10

Buoy

The fender on the buoy is loose and needs repairing. The topside hardware has light to moderate rusting.

Leg A1

The chain has low marine growth and reaches bottom at 90 feet. The 5K sinker is missing.

Leg A2

Divers reported leg A2 loops over A1.

Leg B1

Leg B1 loops over B2 on the bottom. Divers report the legs will uncross under load. An extra swivel is located immediately above the 5K sinker. The anodes have reduced approximately 1/4 to 1/2 inch.

Leg B2

Light marine growth has accumulated on the chain. Two anodes are missing, the first one below the surface and the one below the 20K sinker. The 20K anchor shank is resting on the 5K sinker. The chain and continuity wire are in tension below the 20K sinker, as a result of running over coral heads. Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

Leg C1

The first anode below the surface is hanging by one end of the continuity wire. Both sinkers are in satisfactory condition.

Divers repaired the continuity wire at a depth of 85 feet.

Leg C2

Divers report entire leg is in tension. The continuity wire is in satisfactory condition. The chain runs over some coral after the 20K sinker, and is suspended one foot off the bottom.

Leg D1

The continuity wire is broken 50 feet after the chain hits bottom. Both sinkers are in satisfactory condition.

Divers repaired the continuity wire.

Leg D2

Divers report 1/2 inch of marine growth on the chain. Both sinkers are in satisfactory condition.

Recommended Maintenance Action

Buoy should be refurbished.

UNDERWATER VOLTAGES (VOLTS)

BUOY 10

LOCATION	GROUND LEG							
	A1	A2	B1	B2	C1	C2	D1	D2
BUOY	-.962 -.981	- .962 - .981	-.962 -.981	-.962 -.981	-.962 -.981	-.962 -.981	-.962 -.981	-.962 -.981
REGION I	-.959	- .995 -1.088	-.962 -.950	-.962 -.964	-.961 -.964	-.966 -.970	-.960 -.970	-.961 -.975
REGION II	-.998	-1.088	-.945	-.994	-.978	-.953	-.949 -.966	-.804 -.966
REGION III	-.998 -.942	- .984 - .969 -1.008	-.920 -.944	-.982	-.978	-.947	-.994 -.964	-.975
REGION IV	-.956 -.973	- .961	-.926	-.980 -.984 -.941	-.980 -.937	-.925	-.953	-.800
ANCHOR PENDANT	-.983 -.952 -.951	- .964 - .981	-.886 -.875 -.886	-.980 -.984 -.949	-.934 -.990	-.925 -.924	-.954 -.953	-.801

APPENDIX A-4

Tender Bow/Stern Mooring: This mooring consists of four buoy systems (Buoy 11NE, 11SE, 11SW, and 11NW). Each buoy system consists of a Telephone Buoy and a large (3-1/4") equalizer attached to one of the buoy's pad eyes. A shot of 3-1/4 inch chain passes through this equalizer, and attached to each end of the chain is a 2-3/4 inch equalizer. A ground leg pair passes through each of these equalizers. Thus, each buoy has two ground leg pairs consisting of seven shots of chain and two 150K PEAs. In addition, each buoy has a 180 foot backstay leg attached to the pad eye opposite the one connected to the larger equalizer. The three equalizers, the 3-1/4 inch shot of chain through the large equalizer, and the initial shot through each of the small equalizers are not cathodically protected. Only the lower three shots of each half a leg pair and the backstay leg are cathodically protected with zinc anodes and wire rope continuity cable. Figure A-8 is an isometric view of one of the four buoy systems comprising this mooring. Figure A-9 depicts the regions that were inspected on each half a ground leg pair. Figure A-10 shows the inspection regions for the backstay leg.

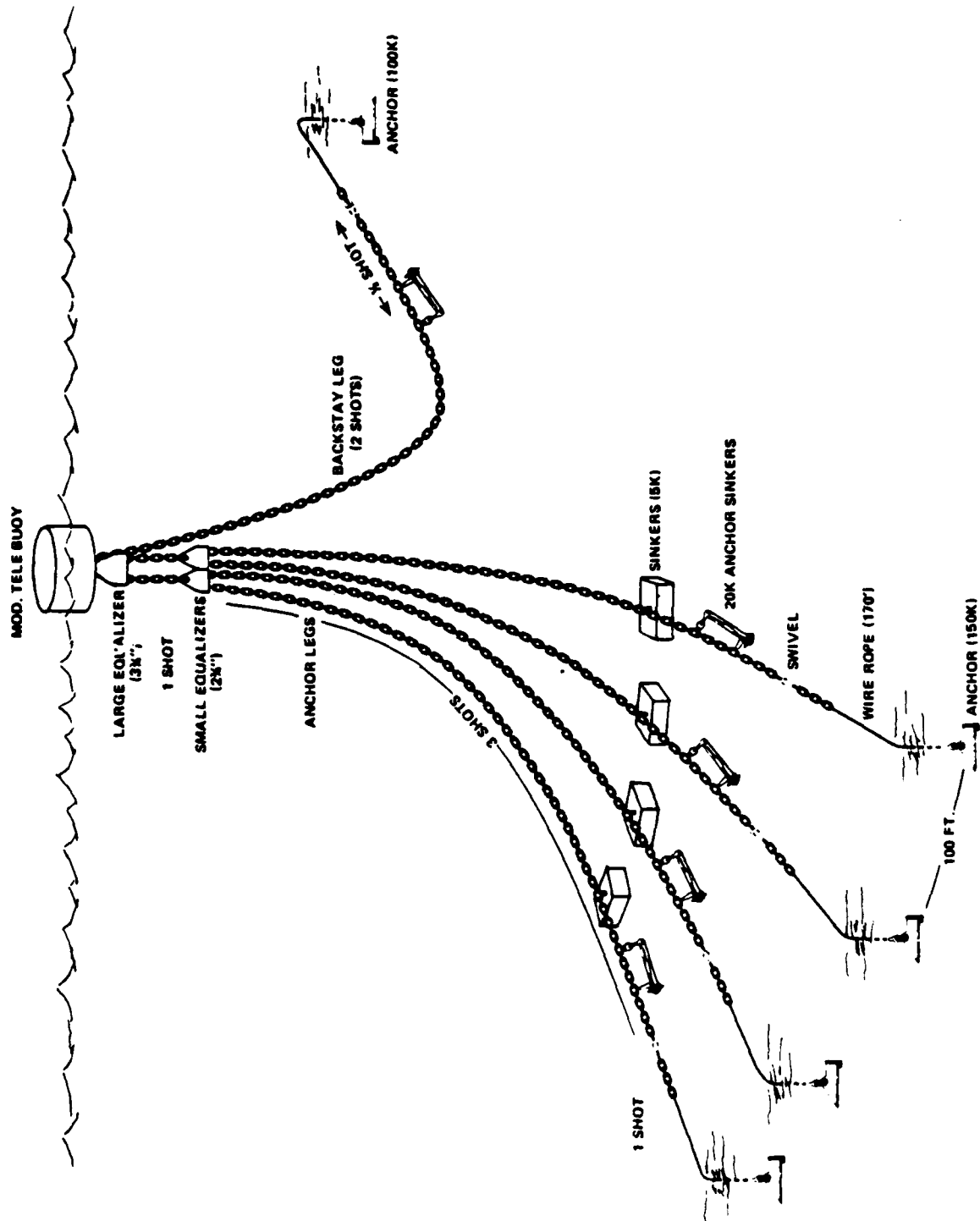


FIGURE A-8. TENDER BOW/STERN MOORING

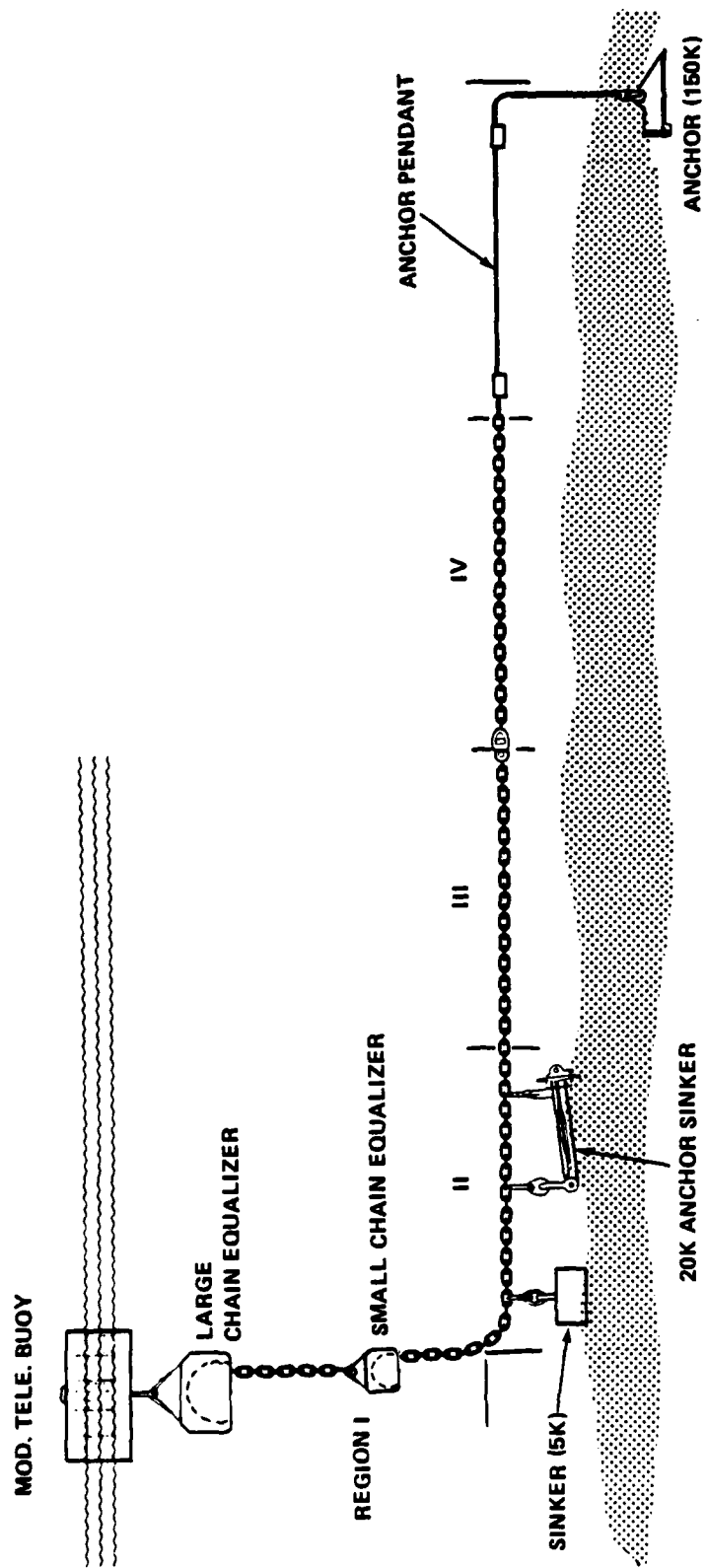


FIGURE A-9. TENDER BOW/STERN MOORING GROUND LEG

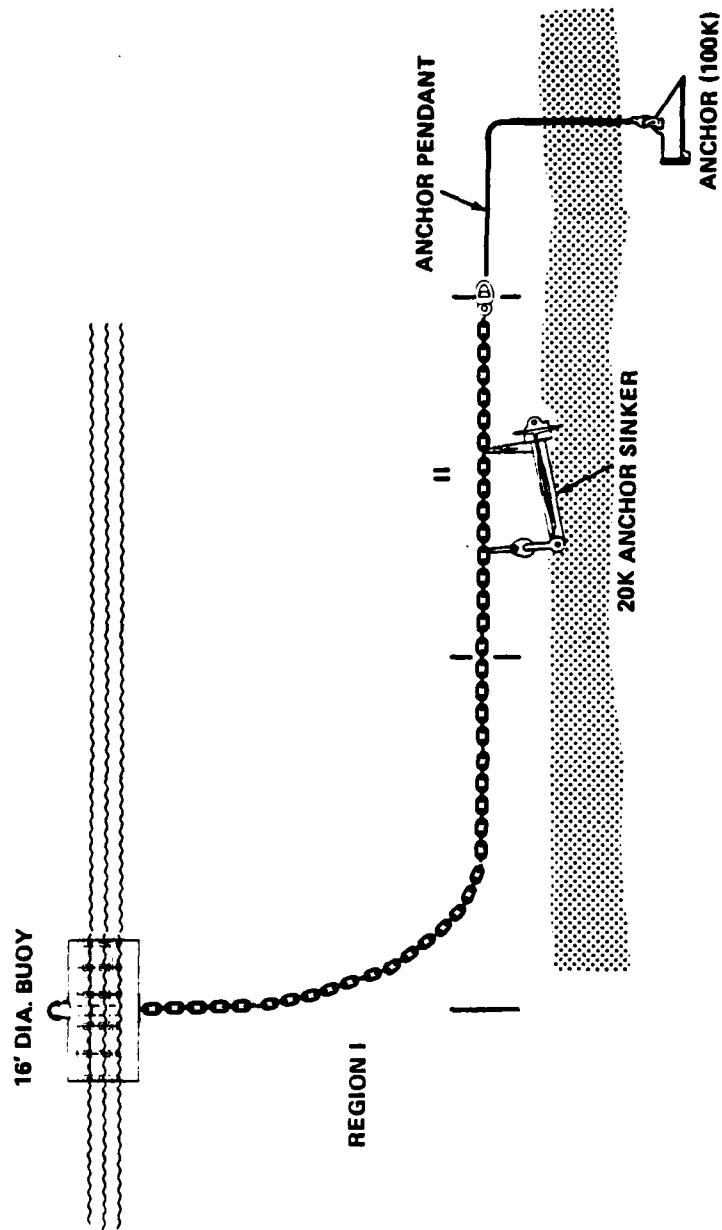


FIGURE A-10. TENDER BOW/STERN MOORING BACKSTAY LEG

BUOY 11SE

Buoy

Buoy fenders are in satisfactory condition. The shackle and shackle pin are rusting away in layers.

Topside of buoy has sections of heavy rust.

Leg A1

Leg A2 loops over A1. The first anode below the small equalizer is missing.* Divers reported moderate amounts of rust could be pinched off of chain by hand. The continuity wire started above the clump and continued down to the swivel.

Divers installed an anode on the last shot of chain.

Leg A2

A stopper still remained on the chain at 90 feet. This was scheduled to be removed during the repair phase. The clump is resting on its side and the 20K sinker is upside down. Corrosion of the chain is the same as leg A1.

Divers installed an anode on the last shot of chain.

Leg B1

The first four anodes on the leg are missing. The continuity wire runs from about 95 feet (the bottom) to the swivel.

Divers installed an anode on the last shot of chain.

Leg B2

Divers reported no continuity wire on the leg. The first three anodes are missing along with the one on the last shot of chain.

Divers installed an anode on the last shot of chain.

Backstay D

The first anode is hanging by the continuity wire. The second anode down is missing. Divers reported an extra clump on this leg, and it is standing on its side.*

The continuity wire runs from just below the surface to the swivel.

Recommended Maintenance Action

Buoy should be refurbished.

*Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

UNDERWATER VOLTAGES (VOLTS)

BUOY 11SE

LOCATION	GROUND LEG			BACKSTAY LEG	
	A1	A2	B1	B2	LOCATION
BUOY	-.921	-.921	-.921	-.921	BUOY
REGION I	-.889	-.899	-.902	-.902	REGION I
	-.868	-.868	-.890	-.890	
	-.882		-.889	-.889	
	-.858			-.980	
REGION II	-.883	-.984	-.730	-.909	REGION II
	-.969		-.870	-.918	
REGION III	-.992	-.972	-.866	-.935	ANCHOR PENDANT
	-.976	-.968	-.882	-.907	
	-.948	-.959	-.972		
REGION IV	-.633	-.635	-.956	-.903	
		-.776		-.738	
ANCHOR PENDANT	-.710	-.776	-.724	-.735	
		-.775	-.727		

BUOY 11SW

Buoy

The shackle and shackle pin are rusting off in layers. One top fender section is missing. Topside of buoy has sections of heavy rusting.

Leg A1

The continuity wire starts at 60 feet and runs down to the swivel. The second anode down is missing.* The 20K sinker is located 90 feet after the 5K sinker.

Leg A2

The two upper anodes are missing.* The continuity wire is in satisfactory condition. The anodes are showing signs of moderate reduction on the corners.

Leg B1

The equalizer is in satisfactory condition. The first two anodes are missing.* The chain is looped around the 20K sinker, and it is standing upright. The chain reaches bottom at 85 feet.

Leg B2

The first two anodes are missing.* There is excess chain after the 20K sinker.

Divers installed an anode on the last shot of chain.

Backstay Leg

The 20K sinker is standing on end with chain looped over it. The continuity wire is broken off at the 20K sinker. Two anodes and the swivel are missing from the leg.*

Recommended Maintenance Action

Buoy should be refurbished.

*Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

UNDERWATER VOLTAGES (VOLTS)

BUOY 11SW

GROUND LEG				BACKSTAY LEG	
LOCATION	A1	A2	B1	B2	D
BUOY	-.940 -.951	-.940 -.951	-.940 -.951	-.940 -.951	BUOY -.940 -.951
REGION I	-.928 -.917	-.917 -.928 -.931	-.915	-.980 -.916	REGION I -.930
REGION II	-.905	-.931	-.914	-.925	REGION II -.923 -.882
REGION III	-.921 -.972 -.907	-.991 -1.000 -.990 -.931	-.948 -.981 -.961	-.975 -.962 -.973	ANCHOR PENDANT -.878
REGION IV	-.905	-.983	-.982 -.973	-.626 -.627 -.625	
ANCHOR PENDANT	-.907 -.900	-.987	-.837 -.838 -.840	-.719 -.715 -.714	

BUOY 11NE

Buoy

The shackle and shackle pin are rusting off in layers. Buoy topside and manholes are rusting heavily.

Leg A1

The chain reaches bottom at 80 feet and the continuity wire starts 10 feet beyond this. It runs down to the swivel. The first four anodes are missing, it's not until after the swivel that there is an anode.* The anchor pendant is wrapped around a coral head before reaching the 20K sinker.

Leg A2

Again the first four anodes are missing.* The length of chain containing the 20K sinker runs over some coral and is stretched 30 feet off the bottom.

Leg B1

The first anode below the equalizer is missing.* Excess chain is sitting on the bottom at 92 feet. The continuity wire starts below the small equalizer and runs down to the swivel.

Leg B2

The clump and 20K sinker are in satisfactory condition. The anodes are moderately reduced.

Backstay Leg

An extra clump which is not required for this leg was located after the 20K sinker.

Recommended Maintenance Action

Buoy should be refurbished.

*Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

UNDERWATER VOLTAGES (VOLTS)

BUOY 11NE

GROUND LEG				BACKSTAY LEG	
LOCATION	A1	A2	B1	B2	D
BUOY	-.914	-.914	-.914	-.914	-.914
REGION I	-.870	-.872	-.957 -.848	①	-.935
REGION II	-.864	-.822 -.890	-.948 -.989	-.978	-.868
REGION III	-.933 -.960 -.970	-.955 -.966	-.978 -.909	-.971	-.749 -.753
REGION IV	-.977	-.948 -.975	-.954 -.925	-.909 -.968 -.950	
ANCHOR PENDANT	-.930	-.926 -.927	-.898	-.849	

① > -.950 mV

BUOY 11NW

Buoy

The shackle and shackle pin are rusting off in layers. Light to moderate rust on topside.

Leg A1

Divers reported the first four anodes missing, but may really be just buried.

Leg A2

The chain and assembly have heavy marine growth. The first two anodes on the leg are missing.* The clump and 20K sinker positions are reversed from what they should be. The sinker is in front of the clump. The shackle pin on the clump is partially coming out. Divers tried to remove the pin to replace it, but could not move it.

Leg B1

The first four anodes are missing.* The 5K sinker and 20K sinker are reversed on the chain.

Leg B2

The 5K sinker is laying on its side. The continuity wire runs from below the small equalizer down to after the fourth anode.

Backstay Leg

The 20K sinker and swivel are in satisfactory condition.

Recommended Maintenance Action

Buoy should be refurbished.

*Since the voltage readings indicate satisfactory cathodic protection at this time, divers did not replace the anodes.

UNDERWATER VOLTAGES (VOLTS)

BUOY 11NW

LOCATION	GROUND LEG			BACKSTAY LEG	
	A1	A2	B1	B2	LOCATION
BUOY	-895 -946	-895 -946	-895 -946	-895 -946	BUOY
REGION I	-870 -850	-892 -870 -873 -860	①	-888 -874 -862 -879	REGION I
REGION II	-860 -863	-850 -943 -973	-858	①	REGION II
REGION III	-873 -970	-953 -993 -892	-913 -967	-971 -934 -918	ANCHOR PENDANT
REGION IV	-931 -941	-919 -956	-964 -952	-887 -967 -957	
ANCHOR PENDANT	-884 -890	-940	-875 -945	-826	

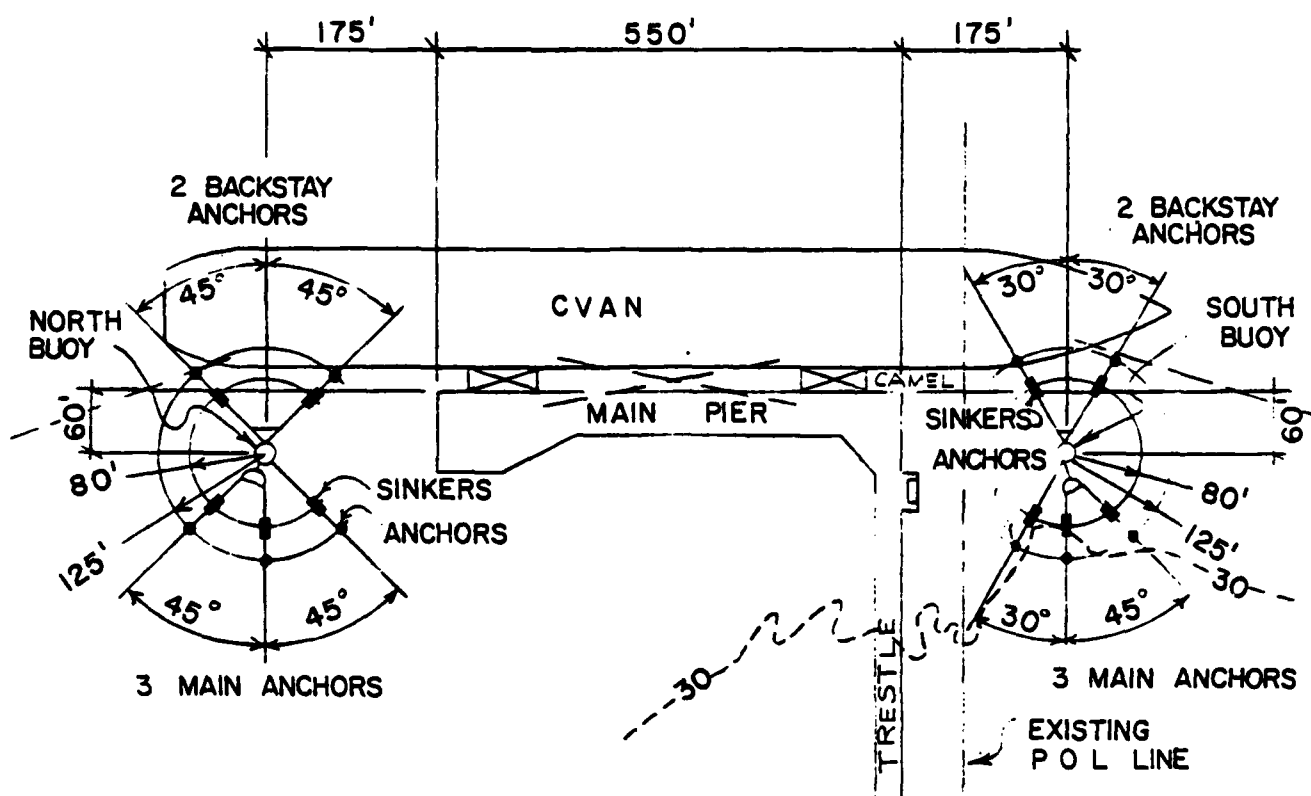
① > -.950 mV

APPENDIX A-5

Buoy Dolphin Mooring System: Each Buoy Dolphin system contains a standard Peg Top Buoy, modified with the addition of a skirt, to a cylindrical shape to provide greater buoyancy. In view of the fact that repairs at such a remote site would be difficult, each buoy was filled with foam to deter damage that could be caused by user ships.

Each of the two systems contains a riser assembly, ground ring, and five legs — a single ground leg, a ground leg pair through an equalizer, and two backstay legs attached to a spider plate. The lower end of each of the five legs is attached to a 2" wire rope anchor pendant leading to a 100 KIP Propellant Embedment Anchor. See Figure A-11 for layout of the legs.

Both Buoy Dolphin systems are cathodically protected. There are two anodes attached by brackets to the bottom of each buoy and two attached to the 20K anchor clump shackled to each chain leg. Wire rope continuity cable (3/4") is weaved through each of the five legs and clamped to the chain and to the anodes on the anchor clumps. (See Figures A-12 through A-21).

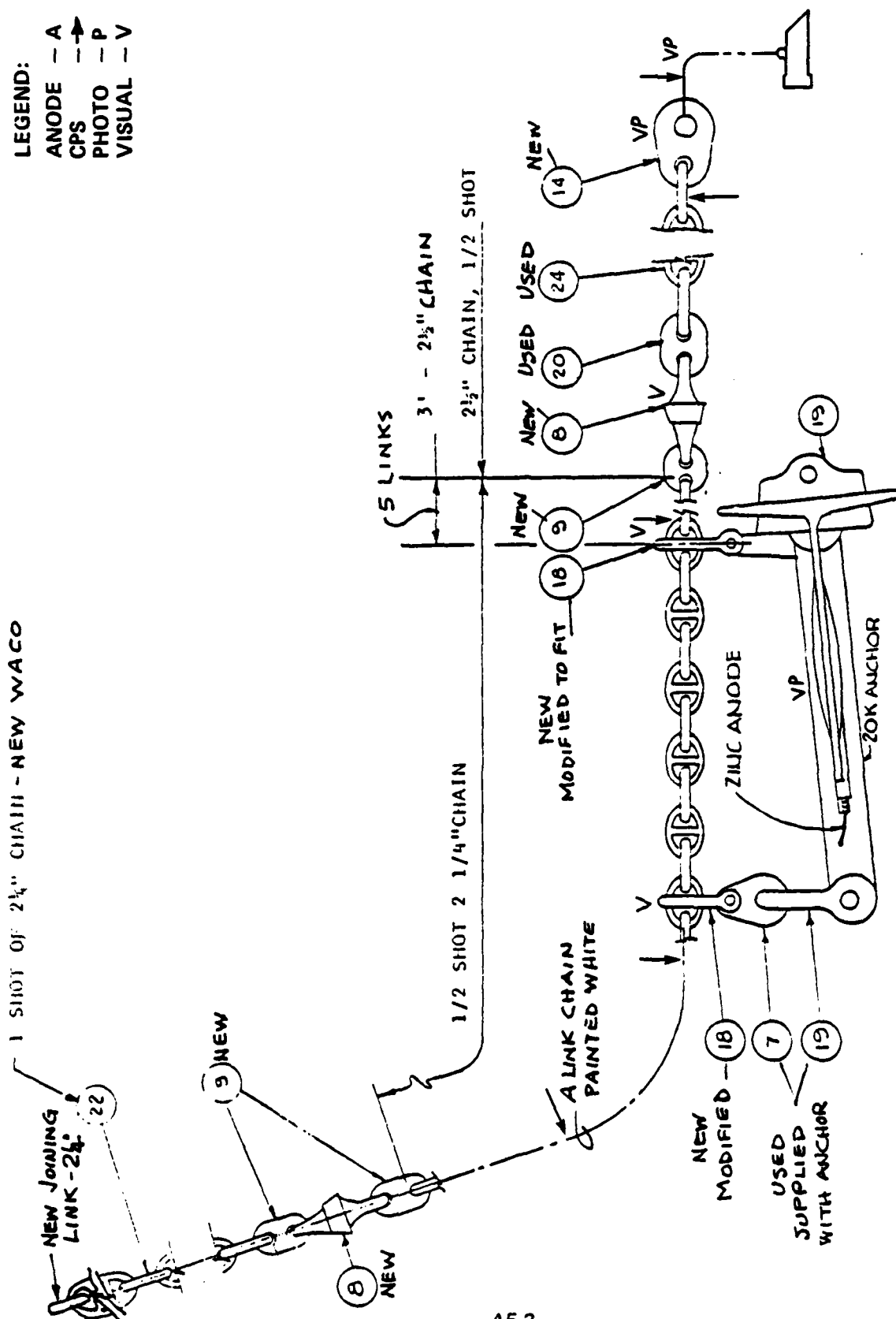


SITE LAYOUT
POL PIER-MOORING BUOY SYSTEM
DIEGO GARCIA B.I.O.T.

Note: ---30--- Indicates Contour Line, Waterdepth in Feet

FIGURE A-11. POL PIER MOORING SITE LAYOUT

LEGEND:
 ANODE - A
 CPS - →
 PHOTO - P
 VISUAL - V



DOUBLE (EQUALIZER)
 MOORING LEG
 HARDWARE COMPONENTS

FIGURE A-12. LEG-NORTH 1

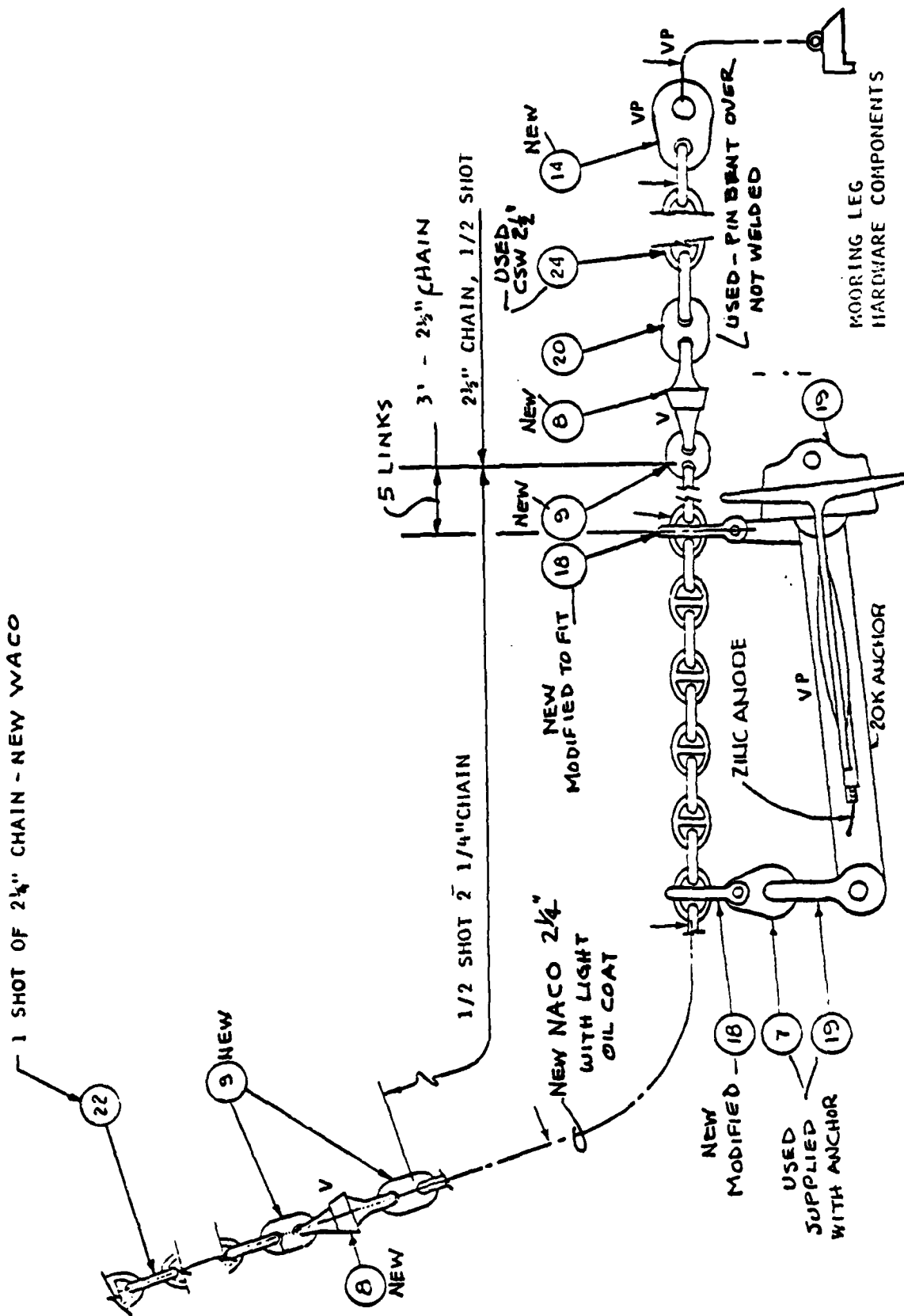


FIGURE A-13. LEG-NORTH 2

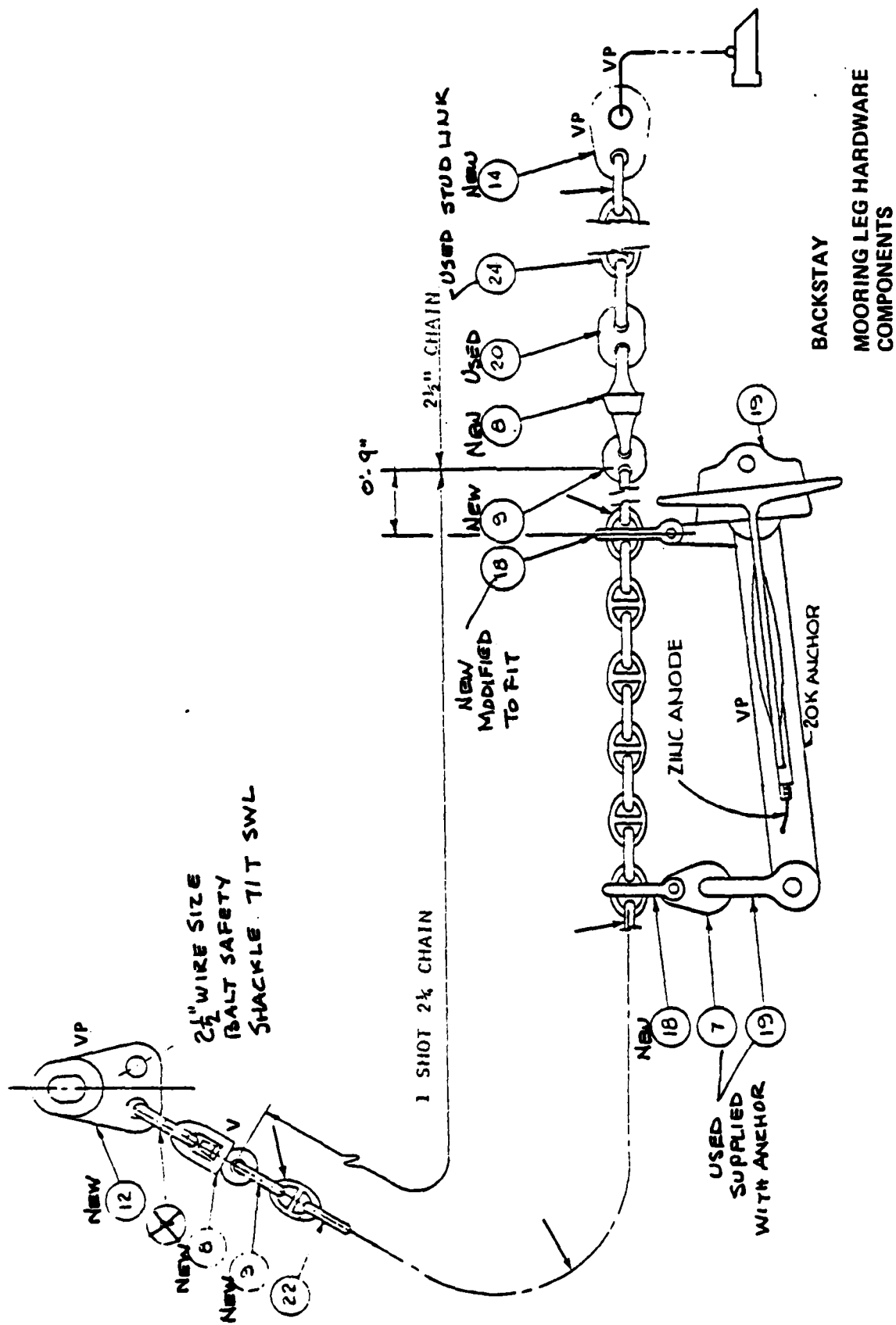
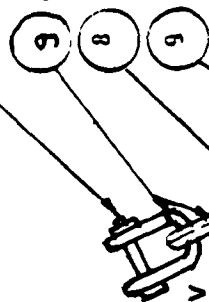


FIGURE A-15. LEG-NORTH 4

NEW 2½" SAFETY SHACKLE
55T SWL (GALVANIZED)

9 ORIGINAL ITEM ⑦
NOT USED



LEG 5

0' - 9"

1 SHOT 2½" CHAIN

USED STUD LINK

2½" CHAIN

NEW
MODIFIED
TO FIT

NEW

ZINC ANODE

VP

20K ANCHOR

NEW 18

NEW 7

19

SUPPLIED
WITH ANCHOR

MOORING LEG HARDWARE
COMPONENTS

FIGURE A-16. LEG-NORTH 5

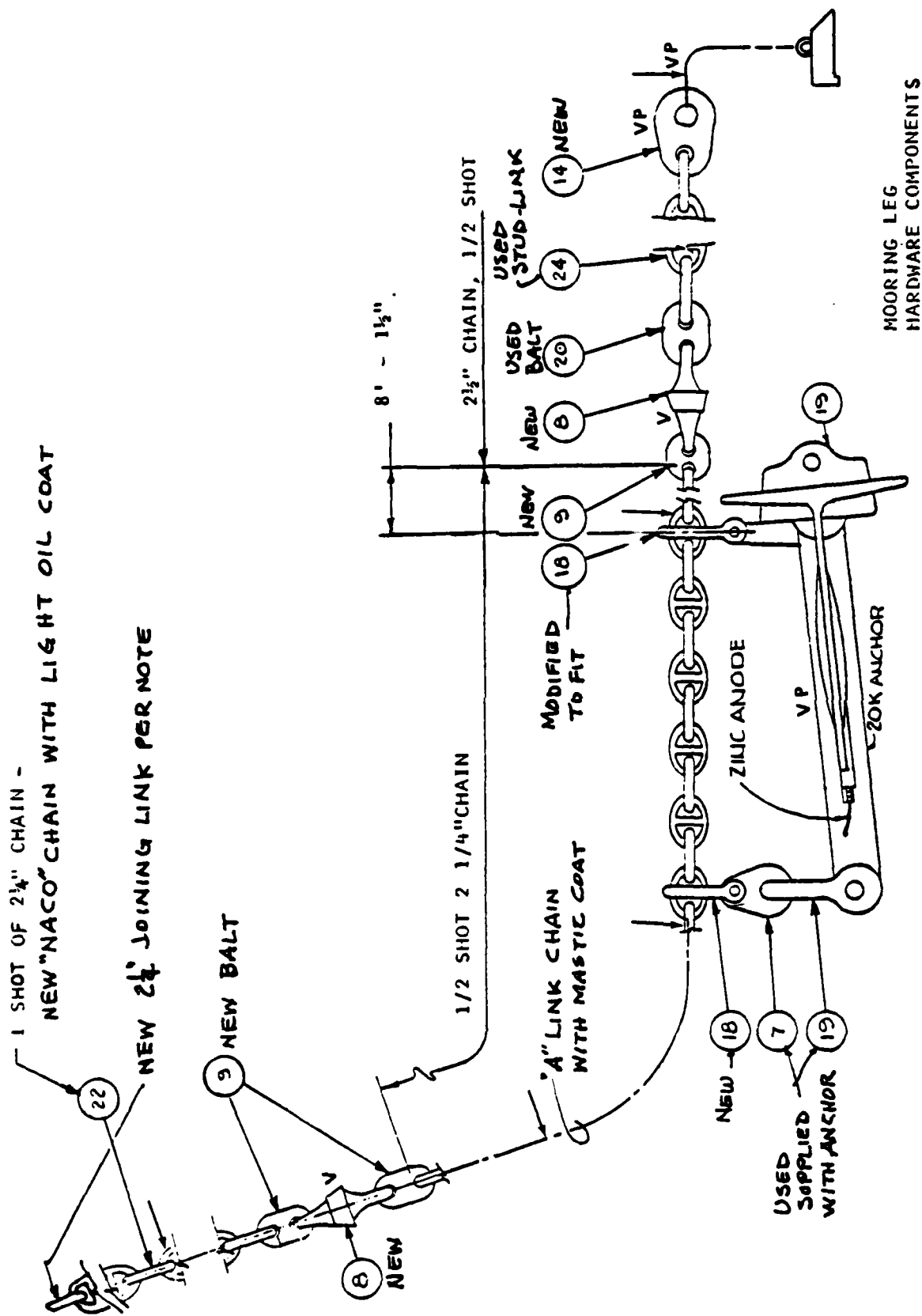


FIGURE A-17. LEG-SOUTH 1

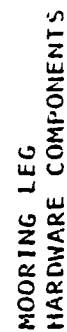
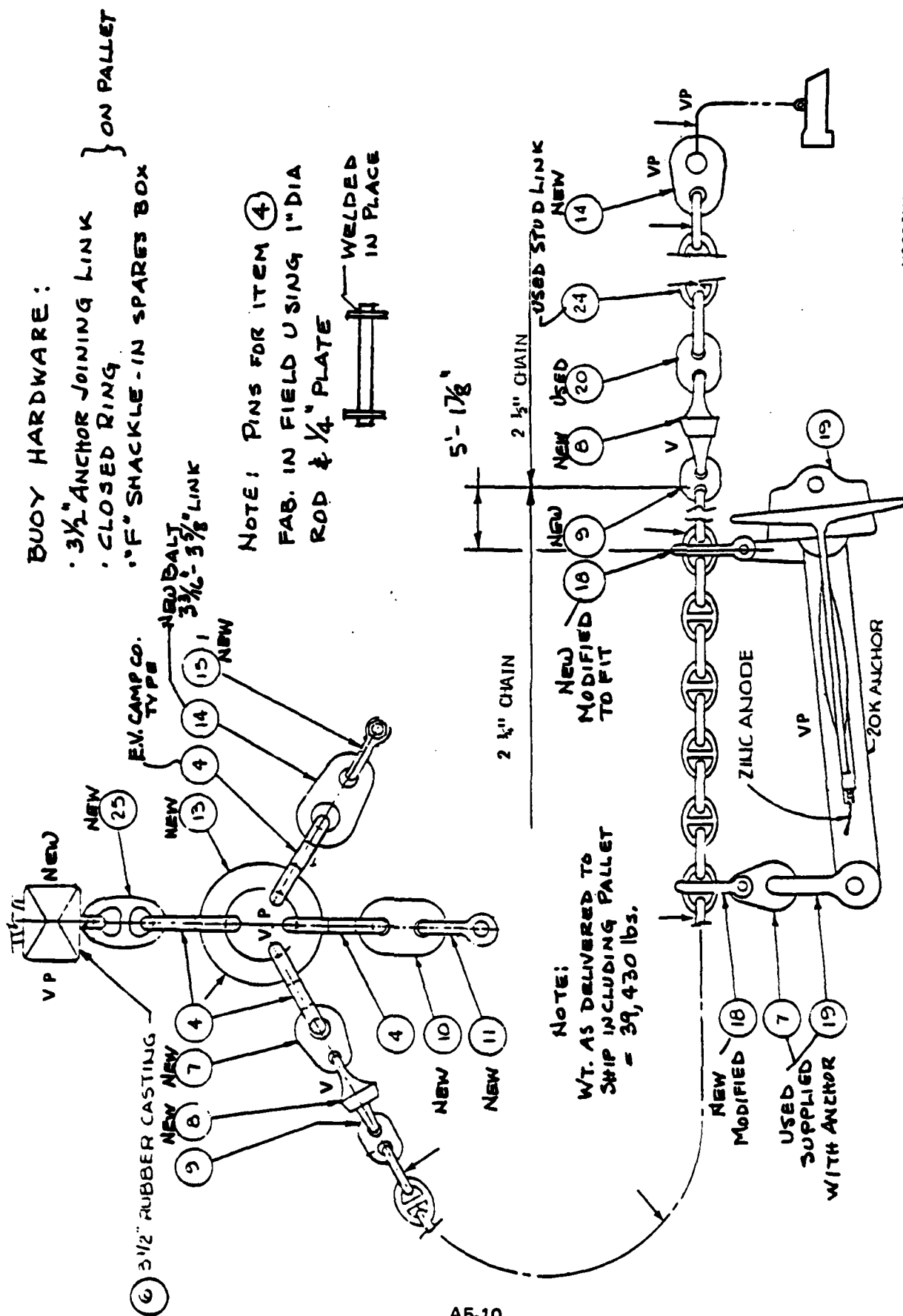


FIGURE A-18. LEG-SOUTH 2



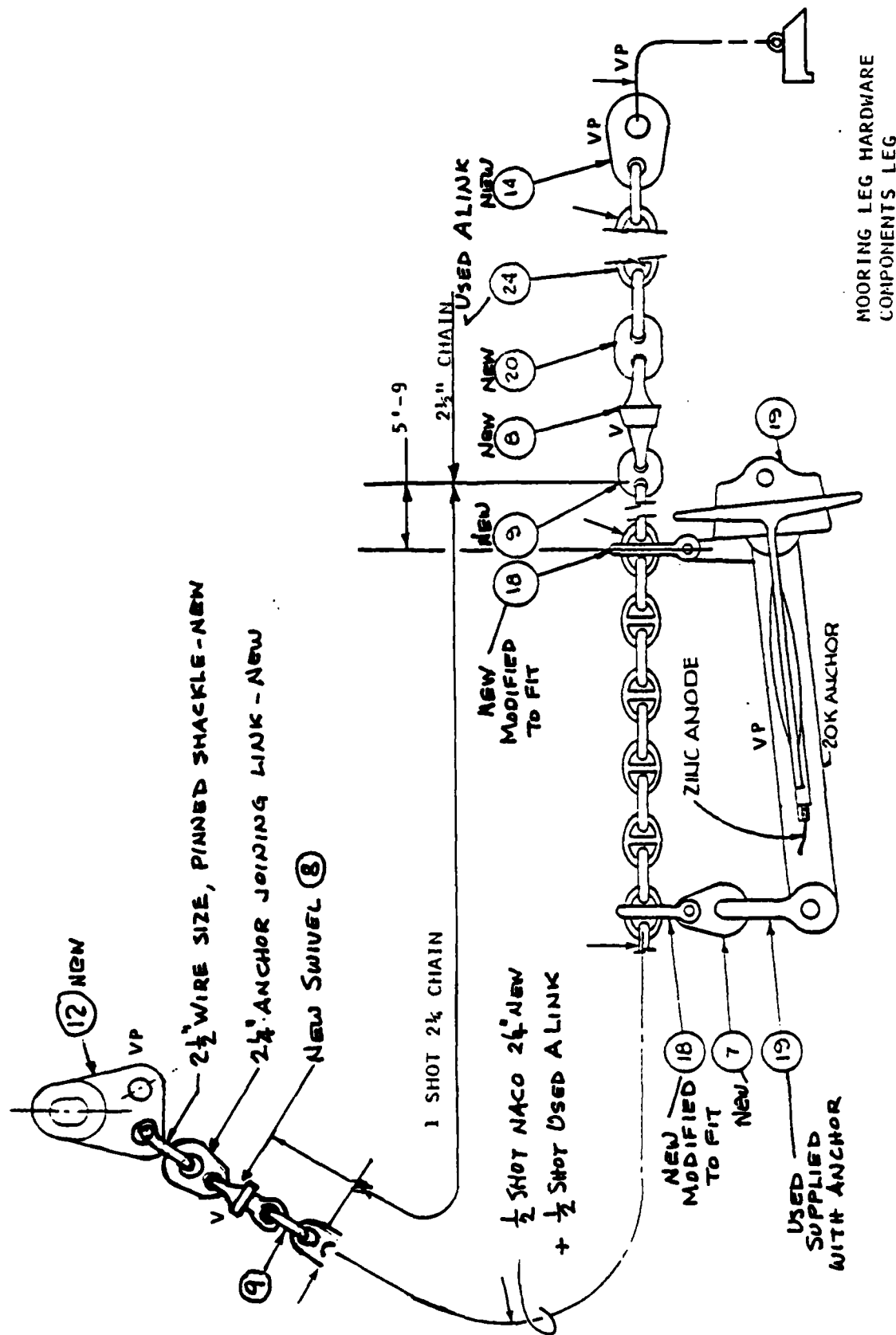


FIGURE A-20. LEG-SOUTH 4

2 1/2" SHACKLE USED IN PLACE OF 7
DO NOT PERMANENTLY ATTACH

15
8 NEW
9 NEW

LEG 5

2 1/2" A LINK WITH
MASTIC/TAR COAT

1 SHOT 2 1/2" CHAIN

5'-9"

2 1/2" CHAIN

NEW USED STUD LINK NEW

14

24

20

8

9

18

NEW MODIFIED

ZINC ANODE

VP

20K ANCHOR

NEW 18

NEW 7

USED 19

"EXTRA" LINK ON
ANCHOR SHACKLE
CUT OFF ON D.G.

MOORING LEG HARDWARE
COMPONENTS

FIGURE A-21. LEG-SOUTH 5

NORTH BUOY DOLPHIN

Buoy

Topside has light covering of rust. Sides of buoy are rusting in the splash zone.

Leg N1

Double link measurements immediately below the equalizer were all +90%. An extra swivel was located in the second shot of chain. Two double link measurements at this point were +90%. The two anchor shackles are in satisfactory condition. Double link measurements around the final swivel were +90%.

VOLTAGES (VOLTS)

EQUALIZER	-.950
at 55 feet	-.990
at 20K sinker	-.900
last link on Leg	-.963

Leg N2

All three double link measurements on both swivels are +90%. The continuity wire only runs on the second quarter of the second shot of chain. The chain is buried after the second swivel. Divers reported 1/2 inch of marine growth on mooring.

VOLTAGES (VOLTS)

EQUALIZER	-.950
2nd Swivel	-.997

Leg N3

Double link measurements were taken after the first swivel and at a depth of 40 feet. Both measurements were +90%. This mooring has moderate marine growth.

VOLTAGES (VOLTS)

1st Swivel	-.911
at 40 feet	-.965
after 2nd Swivel	-.972
last link on Leg	-.860

Leg N4

At a depth of 30 feet double link measurements were +80%. This +80% was also found on links before the anchor clump shackles. Chain after the anchor clump was +90%. The last half of the second shot also had +80% readings. There is slack continuity wire hanging off the top of this leg.

VOLTAGES (VOLTS)

at 30 feet	-.951
at 55 feet (bottom)	-.984
1st 20K sinker Shackle	-.976
last link on Leg	-.957

Leg N5

Double link measurements below the first swivel, and before the first anchor shackle are +80%. A single link measurement of +90 is reported on the chain in between the two anchor shackles. +80% was measured after the second anchor shackle. Excess continuity wire is hanging off the top of the leg.

VOLTAGES (VOLTS)

SPIDER PLATE	-.957
at 30 feet	-.958
1st 20K sinker Shackle	-.957
2nd Anchor Shackle	-.956
last link on Leg	-.639

Recommended Maintenance Action

Buoy should be refurbished.

SOUTH BUOY DOLPHIN

Buoy

Topside has light covering of rust. Sides of buoy are rusting in the splash zone.

Leg S1

Four sets of double link measurements were reported, one below the equalizer, the second on the bottom, the third after the first swivel and the fourth after the second swivel. All four measurements were +90%.

The continuity wire only runs down past the 20K sinker. Beyond this point the voltage readings drop off. Divers report that the zinc anodes are severely reduced.

VOLTAGES (VOLTS)

1st Swivel	-.983
at 20K sinker	-.997
after 20K sinker	-.784
after 2nd Swivel	-.675
Wire Rope	-.660

Leg S2

Double link measurements on both sides of the swivel are +90%. The chain after the anchor clump also was reported at +90%.

VOLTAGES (VOLTS)

EQUAL	-.731
20K sinker	-.980
2nd Swivel	-.992
Wire Rope	-.649

Leg S3

A single link measurement at 30 feet was +90%. The second swivel had double link measurements of +90%. The section of chain rubbing the bottom was -80%. The anodes are in satisfactory condition. A detachable link on the last shot of chain is missing its lead plug. The mooring is currently in tension, should any slack occur in the chain this detachable link could easily come loose. Since this mooring is only a secondary support to the prime lines securing a ship to the POL Pier, restriction on the use of this buoy may be waived by the responsible command.

VOLTAGES (VOLTS)

at 30 feet	-.964
on bottom	-.965
at 20K sinker	-.975
Wire Rope	-.835

Leg S4

Four double link measurements were made, below the first swivel, on the bottom, at the anchor and after the second swivel. All four readings were +90%. Divers reported low marine growth and one inch reduction of anodes.

VOLTAGES (VOLTS)

Spider Plate	-.965
at 20K sinker	-1.004
Wire Rope	-.980

Leg S5

Double link measurements below the first swivel and above the anchor are +90%.

VOLTAGES (VOLTS)

1st Swivel	-.965
Bottom (55 feet)	-.957
at 20K sinker	-.979
Wire Rope	-.960

Recommended Maintenance Action

Buoy should be refurbished.

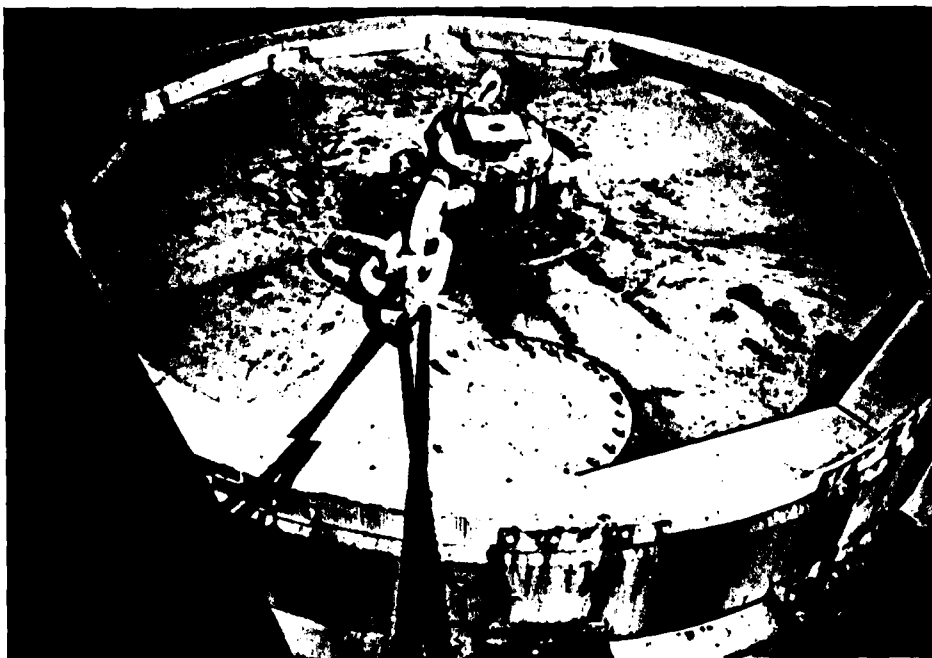
APPENDIX B
PHOTOGRAPHS



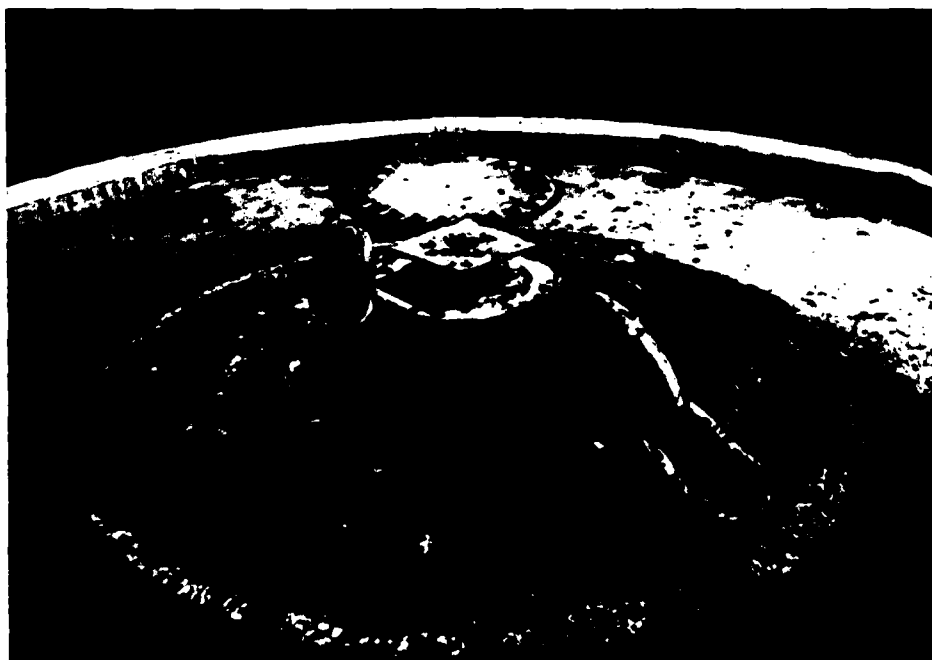
Rusted shackles and top deck plating of Buoy 11 NW.



Typical corrosion of top buoy connecting hardware.



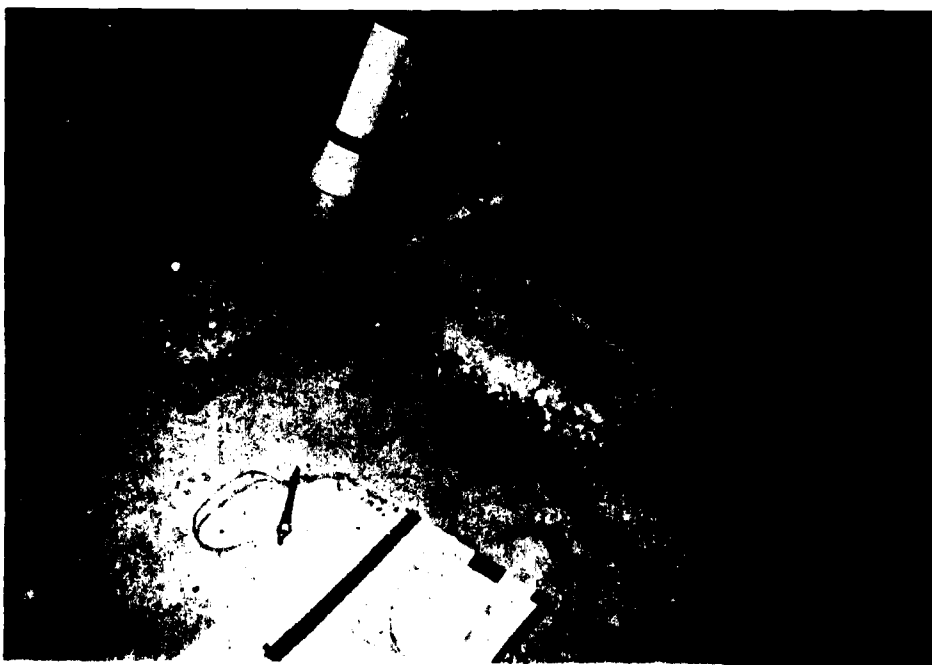
Top of Buoy 7N. Best condition of all buoys inspected.



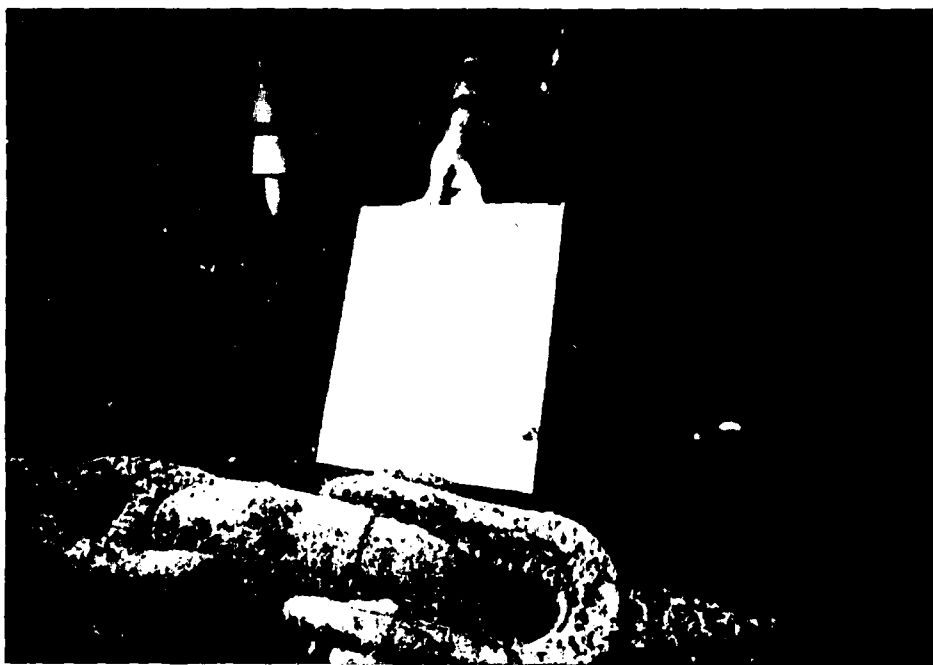
Top of Buoy 7S. Typical condition of most buoys.



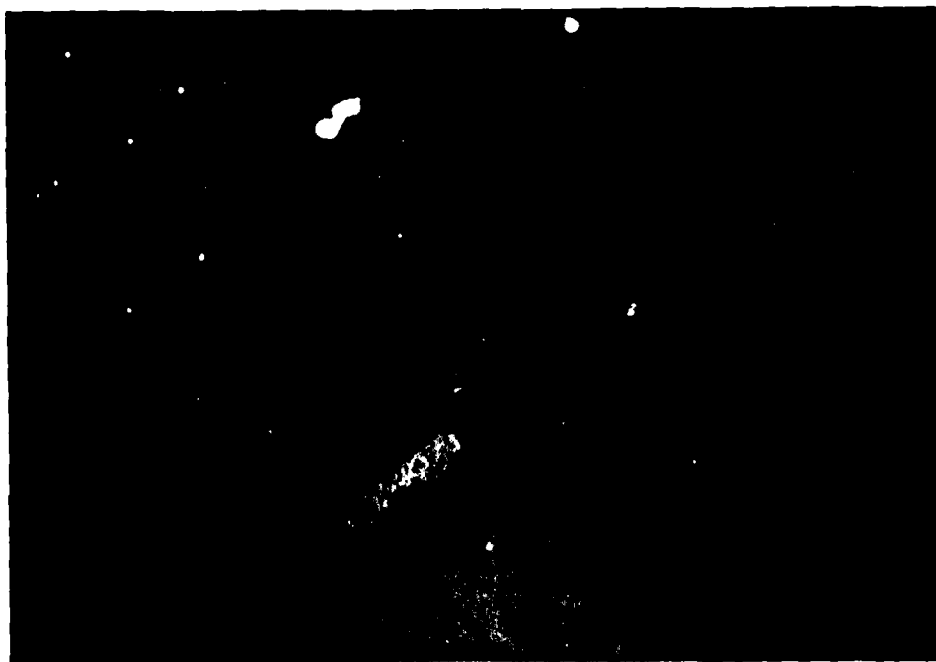
Top of Buoy 8S. Most severe corrosion of upper deck plating.



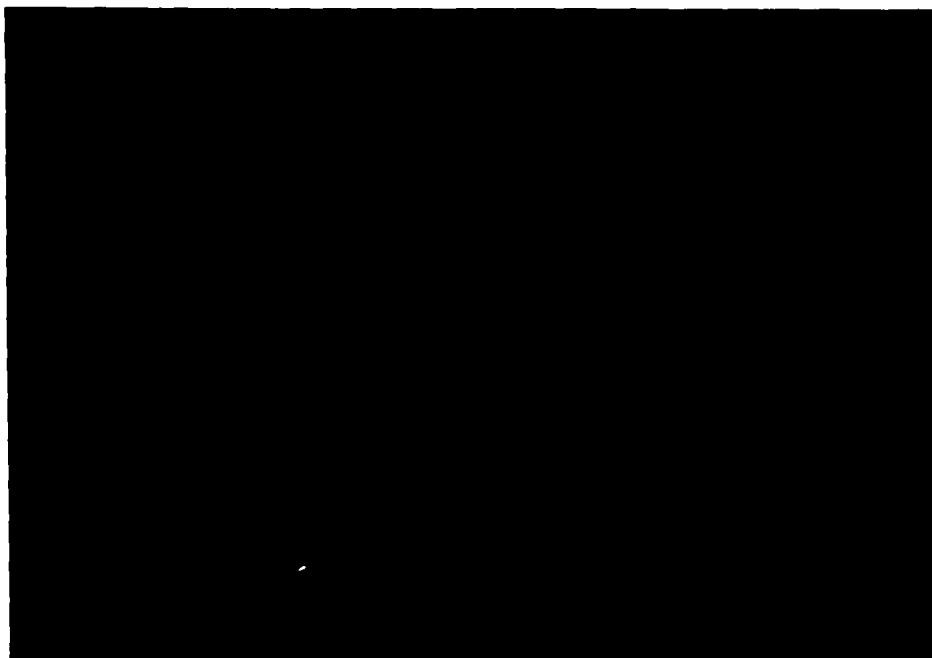
Using an underwater voltmeter, a diver checks the integrity of the cathodic protection system near an anode attached to a ground leg.



Detachable link connecting a ground leg to the swage fitting of an anchor pendant.



Concrete clump and 20K anchor shackled to a ground leg as sinkers.



Bottom view of cargo bow/stern telephone buoy with three leg pairs/equalizers and a backstay leg.



Zinc anode inside a protective cage on the bottom of a Peg Top Buoy.

END

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